ERC2008-05

Evaluation Report

Carfentrazone-ethyl

(publié aussi en français)

23 December 2008

This document is published by the Health Canada Pest Management Regulatory Agency. For further information, please contact:

Publications
Pest Management Regulatory Agency
Health Canada
2720 Riverside Drive
A.L. 6605C
Ottawa, Ontario
K1A 0K9

Internet: pmra_publications@hc-sc.gc.ca
www.pmra-arla.gc.ca
Facsimile: 613-736-3758
Information Service:
1-800-267-6315 or 613-736-3799
pmra_infoserv@hc-sc.gc.ca

Canada

PMRA Document Number: 1591610

ISBN: 978-1-100-11244-2 (978-1-100-11245-9)
Catalogue number: H113-26/2008-5E (H113-26/2008-5E-PDF)

© Her Majesty the Queen in Right of Canada, represented by the Minister of Health Canada, 2008

All rights reserved. No part of this information (publication or product) may be reproduced or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, or stored in a retrieval system, without prior written permission of the Minister of Public Works and Government Services Canada, Ottawa, Ontario K1A 0S5.

Table of Contents

Overview 1
- Registration Decision for Carfentrazone-ethyl 1
- What Does Health Canada Consider When Making a Registration Decision? 1
- What Is Carfentarzone-ethyl? 2
- Health Considerations 2
- Environmental Considerations 4
- Value Considerations 4
- Measures to Minimize Risk 5
- What Additional Scientific Information is Being Requested? 5
- Other Information 6

Science Evaluation 7

1.0 The Active Ingredient, Its Properties and Uses 7
- 1.1 Identity of the Active Ingredient 7
- 1.2 Physical and Chemical Properties of the Active Substances and End-use Product 8
- 1.3 Directions for Use 9
  - 1.3.1 Aim EC 9
- 1.4 Mode of Action 10

2.0 Methods of Analysis 10
- 2.1 Methods for Analysis of the Technical Grade of Active Ingredient 10
- 2.2 Method for Formulation Analysis 10
- 2.3 Methods for Residue Analysis 10

3.0 Impact on Human and Animal Health 11
- 3.1 Toxicology Summary 11
- 3.2 Determining Acceptable Daily Intake 13
- 3.3 Determination of Acute Reference Dose 13
- 3.4 Occupational and Residential Risk Assessment 13
  - 3.4.1 Toxicological Endpoints 13
  - 3.4.2 Occupational Exposure and Risk 14
  - 3.4.3 Residential Exposure and Risk Assessment 15
  - 3.4.4 Aggregate Exposure and Risk Assessment 16
- 3.5 Food Residues Exposure Assessment 16
  - 3.5.1 Residues in Plant and Animal Foodstuffs 16
  - 3.5.2 Dietary Risk Assessment 16
  - 3.5.3 Aggregate Exposure and Risk 17
  - 3.5.4 Proposed Maximum Residue Limits 17

4.0 Impact on the Environment 18
4.1 Fate and Behaviour in the Environment 18
4.2 Effects on Non-target Species 18
4.2.1 Effects on Terrestrial Organisms 19
4.2.2 Effects on Aquatic Organisms 20

5.0 Value 21
5.1 Aim EC 21
5.1.1 Acceptable Efficacy Claims for Aim EC 21
5.1.2 Herbicide Tank Mix Combinations 22
5.2 Phytotoxicity to Host Plants 23
5.2.1 Acceptable Crops for Preplant Burndown Application 23
5.2.2 Acceptable Crops for Hooded Sprayer Application 24
5.2.3 Acceptable Crops for Harvest Aid Treatment 25
5.3 Impact on Succeeding Crops 25
5.3.1 Acceptable Claims for Rotational Crops for Carfentrazone-ethyl 25
5.4 Economics 25
5.5 Sustainability 26
5.5.1 Survey of Alternatives 26
5.5.2 Compatibility with Current Management Practices Including Integrated Pest Management 26
5.5.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance 26

6.0 Pest Control Product Policy Considerations 26
6.1 Toxic Substances Management Policy Considerations 26
6.2 Formulants and Contaminants of Health or Environmental Concern 27

7.0 Summary 27
7.1 Human Health and Safety 27
7.2 Environmental Risk 28
7.3 Value 28

8.0 Regulatory Decision 28

List of Abbreviations 31

Appendix I Tables and Figures 33
Table 1 Residue Analysis 33
Table 2 Acute Toxicity of The Associated End-use Product (AIM 240 g/L EC and AIM 240 g/L EW Herbicide) 34
Table 3 Toxicity Profile of Aim (carfentrazone-ethyl) Technical Herbicide 35
Table 4 Toxicology Endpoints for Use in Health Risk Assessment for Carfentrazone-ethyl 37
Figure 1 Proposed Metabolic Scheme in the Rat 37

Table 5 Integrated Food Residue Chemistry Summary 38
Table 6 Food Residue Chemistry Overview of Metabolism Studies and Risk Assessment 61
Table 7 Environmental Fate of Carfentrazone-ethyl and its Transformation Products 62
Table 8 Environmental Toxicity of Carfentrazone-ethyl and its Transformation Products 64
Table 9 Summary of Screening Level Risk Assessment of Carfentrazone-ethyl to Terrestrial Organisms 67
Table 10 Refined Risk Assessment of Carfentrazone-ethyl to Terrestrial Plants .. 68
Table 11 Summary of Screening Level Risk Assessment of Carfentrazone-ethyl to Aquatic Organisms 69
Table 12 Refined Risk Assessment of Carfentrazone-ethyl to Aquatic Organisms from Spray Drift 70
Table 13 Risk Assessment of Carfentrazone-ethyl for Freshwater Organisms from Predicted Run-off 70
Figure 2 Major Transformation Products and Proposed Transformation Pathway of Carfentrazone 71

Appendix II Supplemental Maximum Residue Limit (MRL) Information—International Situation and Trade Implications 73
Table 1 Differences Between Canadian MRLs and Other Jurisdictions 73

Appendix III Crop Groups: Numbers and Definitions 75

Overview

Registration Decision for Carfentrazone-ethyl

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* (PCPA) and Regulations, has granted conditional registration for the sale and use of Aim (Carfentrazone-ethyl) Technical Herbicide and Aim EC containing the technical grade active ingredient carfentrazone-ethyl to control weeds in numerous crops.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

Although the risk and value have been found acceptable when all risk reduction measures are followed, the applicant must submit additional scientific information as a condition of registration.

This Overview describes the key points of the evaluation, while the Science Evaluation provides detailed technical information on the human health, environmental and value assessments of Aim (Carfentrazone-ethyl) Technical Herbicide and Aim EC.

What Does Health Canada Consider When Making a Registration Decision?

The key objective of the PCPA is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable[1] if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its proposed conditions of registration. The Act also requires that products have value[2] when used according to the label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

---

1 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*.

2 "Value" as defined by Subsection 2(1) of the *Pest Control Products Act* "...the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (a) efficacy; (b) effect on host organisms in connection with which it is intended to be used; and (c) health, safety and environmental benefits and social and economic impact."

To reach its decisions, the PMRA applies modern, rigorous risk-assessment methods and policies. These methods consider the unique characteristics of sensitive population groups (e.g. children) as well as organisms in the environment (e.g. those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties present when predicting the impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk reduction programs, please visit the PMRA's website at www.pmra-arla.gc.ca.

What Is Carfentarzone-ethyl?

Carfentrazone-ethyl is the active ingredient in Aim EC, a selective herbicide for use as a preplant burndown application in a fallow system or between the rows of a wide range of crops in a hooded sprayer application. Aim EC is also used as a harvest aid treatment to desiccate crops in order to facilitate harvest. One application of Aim EC applied as a broadcast treatment with ground application equipment will control several weeds.

Health Considerations

Can Approved Uses of Carfentrazone-ethyl Affect Human Health?

Carfentrazone-ethyl is unlikely to affect health when used according to label directions.

Exposure to carfentrazone-ethyl may occur through diet (food and water) or when handling and applying the product. When assessing health risks, two key factors are considered: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

Toxicology studies in laboratory animals describe the potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed. The health effects noted in animals occur at doses more than 100-times higher (and often much higher) than levels to which humans are normally exposed when using the carfentrazone-ethyl product according to label directions.

Aim EC caused eye and dermal irritation in rabbits. Consequently, the statement "CAUTION—EYE AND SKIN IRRITANT" is required on the product label.

When tested in laboratory animals, carfentrazone-ethyl was not oncogenic, genotoxic or neurotoxic. Animal studies also demonstrated that carfentrazone-ethyl had no effects on reproductive toxicity, developmental toxicity, or teratogenicity. There was no evidence carfentrazone-ethyl affected the immune and endocrine systems. The toxicity data did not demonstrate an increased sensitivity of the young to the toxic potential of carfentrazone-ethyl when compared to the adult animals.

Residues in Water and Food

Dietary risks from food and water are not of concern.

The refined chronic dietary exposure from all carfentrazone-ethyl food uses for the total population, including infants and children, and all representative population subgroups ranged from 11.8% to 47.7% of the acceptable daily intake (ADI). Aggregate exposure from food and water is considered acceptable and below the level of concern. The use of carfentrazone-ethyl on crops does not constitute an unacceptable chronic dietary risk (i.e. in food and drinking water) to any segment of the population, including infants, children, adults and seniors.

The *Food and Drugs Act* prohibits the sale of adulterated food, that is, food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for Food and Drugs Act purposes through the evaluation of scientific data under the PCPA. Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

Supervised residue trials conducted throughout the United States using end-use products containing carfentrazone-ethyl at the proposed rate and exaggerated rates in or on numerous crops are sufficient to support the proposed maximum residue limits. The MRLs for this active ingredient can be found in the Science Evaluation of this document.

Occupational Risks From Handling Aim EC

Occupational risks are not of concern when Aim EC is used according to the proposed label directions, which include protective measures.

Farmers and custom applicators who mix, load or apply Aim EC as well as field workers reentering recently treated fields can come in direct contact with carfentrazone-ethyl residues on the skin. Therefore, the label specifies that anyone mixing and loading Aim EC must wear a long-sleeved shirt, long pants, chemical-resistant gloves and shoes plus socks and that anyone applying the product must wear a long-sleeved shirt, long pants and shoes plus socks. Taking into consideration the label requirements the expectation that occupational exposure is to be short-term for farmers and intermediate-term for custom applicators, and that the herbicide is applied only once per season, the risk to farmers, applicators or field workers is not a concern.

For bystanders, exposure is expected to be much less than that for workers and is considered negligible. Therefore, health risks to bystanders are not of concern.

Environmental Considerations

What Happens When Carfentrazone-ethyl Is Introduced Into the Environment?

Carfentrazone-ethyl poses a potential risk to terrestrial plants, therefore, risk reduction measures must be observed.

When carfentrazone-ethyl is applied for control of weeds in crops, some of the active ingredient finds its way into soil and water. Carfentrazone-ethyl, however, is rapidly broken down by soil microbes and by chemical reaction in water. Thus, it is not expected to persist in the environment. Its major transformation products will be present in soil and aquatic systems for a longer period of time. Laboratory studies indicate carfentrazone-ethyl and its transformation products are mobile in soil. However, there is no field evidence that the use of this herbicide will result in groundwater contamination, indicating that leaching in soil is offset by biotransformation processes. Therefore, potential for groundwater contamination would be low.

When carfentrazone-ethyl is used for weed control in crops, there is a potential that non-target plant species on land and in water may be exposed to the chemical as a result of spray drift or runoff. Some plant species are sensitive to carfentrazone-ethyl and would be adversely affected. To minimize the potential exposure, strips of land (buffer zones) between the agricultural field and the non-target terrestrial or aquatic areas will be left unsprayed. Carfentrazone-ethyl presents negligible risk to wild birds and mammals, bees and other arthropods as well as to aquatic organisms like fish, amphibians, invertebrates and plants. The width of these buffer zones will be specified on the product label.

Value Considerations

What Is the Value of Aim EC?

For the control of several broad leaf weeds, Aim EC may be applied in a fallow system or as a preplant burndown in succulent or dried legume vegetables, fruiting vegetables, cucurbit vegetables, cereal grains, oilseeds and potatoes.

Aim EC may be applied using hooded sprayers between the rows in root and tuber vegetables, bulb vegetables, leafy vegetables, brassica (cole) leafy vegetables, succulent or dried legume, fruiting vegetables, cucurbit vegetables, pome fruits, stone fruits and berries to control several broad leaf weeds.

Aim EC may be applied as a harvest aid treatment to dried shelled peas and beans, potatoes, soybeans, barley, millet, oats, sorghum, triticale and wheat.

Carfentrazone-ethyl is compatible with integrated weed management practices and with conservation tillage and conventional crop production systems. Carfentrazone-ethyl is applied after weed emergence; therefore, growers can better assess whether the herbicide is suitable for the particular weed species present. Carfentrazone-ethyl also provides control of both conventional and glyphosate tolerant volunteer canola.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law.

The key risk-reduction measures being proposed on the label of Aim EC to address the potential risks identified in this assessment are as follows.

Key Risk-Reduction Measures

- **Human Health**

As there is a concern with users coming into direct contact with Aim EC on the skin or through inhalation of spray mists, anyone mixing and loading Aim EC must wear a long-sleeved shirt, long pants, chemical-resistant gloves, shoes and socks. Anyone applying the product must wear a long-sleeved shirt and long pants. In addition, standard label statements to protect against drift during application are on the label.

- **Environment**

Mitigative measures are required to protect sensitive terrestrial and aquatic plant species from the use of carfentrazone-ethyl. These mitigative measures include precautionary statements on the label regarding environmental hazards and the directions for use as well as a 3 m buffer zone to protect sensitive plants from spray drift.

What Additional Scientific Information is Being Requested?

Although the risks and value have been found acceptable when all risk reduction measures are followed, the applicant must submit additional scientific information as a condition of registration. More details are presented in the Science Evaluation of this Evaluation Report and in the Section 12 Notice associated with these conditional registrations.

Value

Confirmatory data are required to support the list of glyphosate tank mix partners that can be tank mixed with Aim EC in preplant burndown or fallow system applications.

Other Information

As these conditional registrations relate to a decision on which the public must be consulted,[3] the PMRA will publish a consultation document when there is a proposed decision on applications to convert the conditional registrations to full registrations or on applications to renew the conditional registrations, whichever occurs first.

The test data cited in this Evaluation Report (i.e. the test data relevant in supporting the registration decision) will be made available for public inspection when the decision is made to convert the conditional registrations to full registrations or to renew the conditional registrations (following public consultation). If more information is required, please contact the PMRA's Pest Management Information Service by phone (1-800-267-6315) or by e-mail (pmra_infoserv@hc-sc.gc.ca).

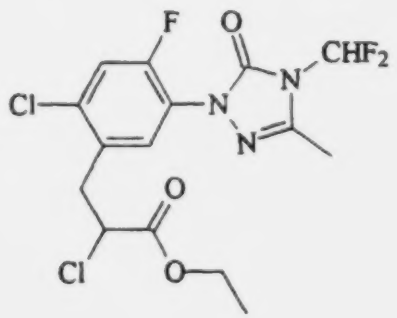
[3] As per subsection 28(1) of the *Pest Control Products Act*.

Science Evaluation

Carfentrazone-ethyl

1.0 The Active Ingredient, Its Properties and Uses

1.1 Identity of the Active Ingredient

Active substance		Carfentrazone-ethyl
Function		Herbicide
Chemical name		
1.	**International Union of Pure and Applied Chemistry (IUPAC)**	Ethyl 2-chloro-3-[2-chloro-4-fluoro-5-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl)phenyl]propanoate
2.	**Chemical Abstracts Service (CAS)**	Ethyl α,2-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl]-4-fluorobenzene propanoate
CAS number		128639-02-1
Molecular formula		$C_{15}H_{14}Cl_2F_3N_3O_3$
Molecular weight		412.19 g/mole
Structural formula		
Purity of the active ingredient		91.7 % (limits: 88.95–94.45%)

1.2 Physical and Chemical Properties of the Active Substances and End-use Product

Technical Product—Aim (Carfentrazone-ethyl) Technical Herbicide

Property	Result	
Colour and physical state	Yellow-orange liquid	
Odour	Faint petroleum like odour	
Melting range	Not applicable	
Boiling point or range	350–355°C	
Density at 25°C	1.457 g/cm^3	
Vapour pressure at 20°C	5.4×10^{-8} mm Hg (7.2×10^{-6} Pa)	
Ultraviolet (UV)–visible spectrum	The product does not absorb UV at > 300 nm.	
Solubility in water at 20°C	12 µg/mL	
Solubility in organic solvents at 20°C (g/100 mL)	**Solvent** Toluene Hexane Miscible in all proportions in acetone, ethanol, ethyl acetate and methylene chloride	**Solubility** 0.9 0.03
n-Octanol–water partition coefficient (K_{ow})	$\log K_{ow} = 3.36$	
Dissociation constant (pK_a)	The product does not contain any functional groups that can dissociate in water.	
Stability (temperature, metal)	Stable to heat. No effect on aluminum and stainless steel.	

End-use Product—Aim EC

Property	Result
Colour	Yellow-orange
Odour	Liquid at 20°C
Physical state	Faint petroleum like odour
Formulation type	Emulsifiable concentrate

Property	Result
Guarantee	Carfentrazone-ethyl, 240 g/L nominal (limits 233–247 g/L)
Container material and description	Fluorinated high density polyethylene bottle (HDPE)
Density	1.075 g/mL
pH of 1% dispersion in water	4.66
Oxidizing or reducing action	Does not contain strong oxidizing or reducing agents.
Explodability	The product does not contain any explosive properties.

1.3 Directions for Use

1.3.1 Aim EC

Aim EC is a selective herbicide for use as a preplant burndown application in a fallow system or between the rows of a wide range of crops using a hooded sprayer application. Aim EC is also used as a harvest aid treatment to desiccate crops in order to facilitate harvest. One application of Aim EC applied as a broadcast treatment with ground application equipment will control the following weeds.

Table 1.3.1 Weed Control Claims for Aim EC

Herbicide Rate	Weeds Controlled
8.76 g a.i./ha (36.5 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	Lamb's quarters (up to 7.5 cm tall), morning glory (up to 3 leaves), Eastern black nightshade, redroot pigweed, velvetleaf, tall waterhemp (up to 5 cm tall)
13.92 g a.i./ha (58 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	All the weeds controlled at 36.5 mL product/ha plus: lamb's quarters, round-leaved mallow, morning glory, hairy nightshade, field pennycress, prostrate pigweed, smooth pigweed, tumble pigweed, common purslane, Pennsylvania smartweed (seedling), tansy mustard, tall waterhemp
17.52 g a.i./ha (73 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	All the weeds controlled at 58 mL product/ha plus: carpetweed, cocklebur, jimsonweed, kochia, Eastern black nightshade, volunteer canola, glyphosate tolerant volunteer canola

Herbicide Rate	Weeds Controlled
28 g a.i./ha (117 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	All the weeds controlled at 73 mL product/ha plus: burclover, prickly lettuce, Venice mallow (up to 5 cm tall), corn spurry

Note: Control of the listed weeds up to ten (10) cm in height or as specified.

1.4 Mode of Action

Carfentrazone-ethyl is classified as a Group 14 Herbicide (refer to Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*). The primary mode of action of carfentrazone-ethyl is the inhibition of the enzyme protoporphyrinogen oxidase in the chlorophyll biosynthetic pathway and leads to the subsequent buildup of phytotoxic intermediates and disruption of cell membranes. Plants treated with carfentrazone-ethyl become necrotic and die shortly after treatment. Initial symptoms are observed within hours and death occurs within a few days.

2.0 Methods of Analysis

2.1 Methods for Analysis of the Technical Grade of Active Ingredient

The methods provided to analyse the active ingredient and the impurities in Aim (Carfentrazone-ethyl) Technical Herbicide have been validated and assessed to be acceptable for the determinations.

2.2 Method for Formulation Analysis

The method provided to analyse the active ingredient in the formulation has been validated and assessed to be acceptable for use as an enforcement analytical method.

2.3 Methods for Residue Analysis

Gas chromatography methods with either electron capture detection (GC/ECD) or mass spectrometry detection (GC/MS) were developed and proposed for data generation and enforcement purposes. These methods fulfilled the requirements with regards to specificity, accuracy and precision at the respective method limits of quantitation (LOQs). Acceptable recoveries (70–120%) were obtained in plant and animal matrices. Adequate extraction efficiencies were demonstrated using radiolabelled corn forage, wheat straw, goat kidney and milk samples analysed using the enforcement method. The methods for determination of parent and metabolites in soil fulfilled the requirements with regards to selectivity, accuracy and precision at the respective method limit of quantitation. Acceptable recoveries (70–120%) were obtained in soil. Methods for residue analysis are summarized in Appendix I, Table 1.

3.0 Impact on Human and Animal Health

3.1 Toxicology Summary

The PMRA conducted a detailed review of the toxicological database for carfentrazone-ethyl. The database is complete, consisting of the full array of laboratory animal (in vivo) and cell culture (in vitro) toxicity studies currently required for health hazard assessment purposes. The studies were carried out in accordance with currently accepted international testing protocols and Good Laboratory Practices. The scientific quality of the data is acceptable, and the database is considered adequate to characterize the toxicity of this pest control product.

Aim (carfentrazone-ethyl) Technical Herbicide is of low acute toxicity by the oral, dermal and inhalation routes in rats. It was non-irritating to minimally irritating when applied to the skin and eyes of rabbits. Using the Buehler method, the result of skin sensitization testing in guinea pigs was negative.

The two end use formulations of carfentrazone-ethyl tested, Aim EC and Aim 240 g/L EW, are of low acute toxicity by the oral, dermal and inhalation routes in rats. They are minimally irritating to the rabbit skin and are mildly irritating to the rabbit eyes. Based on the Buehler protocol and when tested in guinea pigs, the end-use formulations are not dermal sensitizers.

The absorption, distribution, elimination, and metabolism of carfentrazone-ethyl were studied in Sprague-Dawley rats. Preliminary studies demonstrated that there were no differences in the metabolism of ^{14}C-phenyl- and ^{14}C-carbonyl-labelled carfentrazone-ethyl. The amount of radioactivity recovered in expired air (^{14}C-CO2) was minimal (<0.02%). Based on the results, only 14C-phenyl-carfentrazone-ethyl was used in subsequent metabolism/pharmacokinetics studies and radioactivity in expired air was not investigated.

Orally administered ^{14}C-phenyl-carfentrazone-ethyl in corn oil at a single low-dose (5 mg/kg bw), single high-dose (1000 mg/kg bw) or repeat low-dose (5 mg of carfentrazone-ethyl/kg bw/d for 14 days, followed by 5 mg ^{14}C-carfentrazone-ethyl on day 15) indicated that ^{14}C-carfentrazone-ethyl was readily excreted in the urine and feces of rats. More than 85% of the administered dose (AD) was excreted within 24 hours. Recovery of the AD averaged >96% (72–87% in urine; 10–26% in feces) in both sexes. Minimal tissue retention was found.

The metabolism of carfentrazone-ethyl was rapid and extensive, and was found to occur through a variety of pathways involving hydrolysis of the ester moiety to form carfentrazone-ethyl-chloropropionic acid, followed by oxidative hydroxylation of the methyl group to form 3-hydroxymethyl-carfentrazone-ethyl-chloropropionic acid or dehydrochlorination to form carfentrazone-ethyl-cinnamic acid. Dechlorination of carfentrazone-ethyl-chloropropionic acid formed carfentrazone-ethyl-propionic acid and hydroxylation of the methyl group of carfentrazone-ethyl-propionic acid formed 3-hydroxymethyl-carfentrazone-ethyl-propionic acid. The metabolites identified in pooled urine and fecal samples were carfentrazone-ethyl-chloropropionic acid (49–66%), 3-OH-carfentrazone-ethyl-chloroproionic acid (18–34%), 3-OH-carfentrazone-ethyl-propionic acid (2–9%), carfentrazone-ethyl-cinnamic acid (0.3–1.5%), and

the parent compound carfentrazone-ethyl (0.1–3.0%). Excretion profiles in urine and feces did not vary significantly with the dosing regimen and there were no significant sex differences.

Radioactive residues in plasma and red blood cells (RBC) were investigated over time after a single oral administration of ^{14}C-phenyl-carfentrazone-ethyl in mice and rats. The results indicated that the absorption and elimination profiles of ^{14}C-phenyl-carfentrazone were similar between the two species. The AD was rapidly absorbed and eliminated by all dose groups. In most cases, the female had a higher blood radioactivity level than the male. Two significant metabolites found in the pooled mouse urine and pooled rat urine were carfentrazone-ethyl-chloropropionic acid and 3-hydroxymethyl-carfentrazone-ethyl-chloropropionic acid.

A 21-day dermal study showed no skin irritation or systemic toxicity after repeated applications of carfentrazone-ethyl at the limit dose of 1000 mg/kg bw/d to the shaved skin of albino rats.

In short- and long-term toxicity studies in mice, rats and dogs, carfentrazone-ethyl indicated systemic toxicity associated with high dose levels and organ toxicity associated with metabolism and detoxification of orally administered carfentrazone-ethyl. Observed systemic toxicity at high doses included effects on food consumption, body weight, and body-weight gain. Organ toxicity invariably involved the liver (increased weight, hepatocytomegaly, single cell necrosis, increased mitotic rate, and pigment and porphyrin deposit) and the kidneys (pigmentation, medullary dilation, regenerative tubular epithelium). One other notable observation was the effect of carfentrazone-ethyl on porphyrin metabolism, resulting in increased urinary excretion of various porphyrin components.

Long-term dietary toxicity studies in mice and rats did not provide evidence of oncogenic potential of carfentrazone-ethyl.

No evidence of mutagenic potential of carfentrazone-ethyl was observed in a battery of in vitro and in vivo genotoxicity assays assessing gene mutation, chromosome aberration, and DNA damage/repair.

When tested in the rat, carfentrazone-ethyl did not affect the reproductive performance or reproductive parameters. Developmental studies in rats and rabbits did not demonstrate the teratogenic potential of carfentrazone-ethyl. There was no evidence of increased susceptibility in the young.

Carfentrazone-ethyl was not neurotoxic as demonstrated in acute and 90-day neurotoxicity studies in rats.

For assessing risks from potential residues in food or from products used in or around homes or schools, the PCPA requires the application of an additional 10-fold factor to threshold effects. This factor should take into account potential prenatal and postnatal toxicity and completeness of the data with respect to the exposure of, and toxicity to, infants and children. A different factor may be determined to be appropriate on the basis of reliable scientific data.

With respect to the completeness of the toxicity database, no additional studies are required at this time since extensive data are available on carfentrazone-ethyl. The potential prenatal and postnatal toxicity in rats and potential developmental toxicity in rabbits provided no indication of increased susceptibility of rat or rabbit fetuses to in utero exposure to carfentrazone-ethyl. In the reproductive toxicity study, there was no indication of increased susceptibility in the offspring compared to parental animals. On the basis of this information, the 10 × PCPA factor can be removed.

Results of the acute and chronic tests conducted on laboratory animals with carfentrazone-ethyl and its associated end-use product are summarized in Appendix I, Tables 2 and 3.

3.2 Determining Acceptable Daily Intake

The lowest no observed adverse effect level (NOAEL) of 9 mg/kg bw/d was established in the combined 2-year dietary toxicity and oncogenicity study.

Based on the lowest NOAEL of 9 mg/kg bw/d and the standard safety/uncertainty factor (SF/UF) of 100 (margin of exposure) to account for the interspecies and intraspecies variations, an acceptable daily intake (ADI) of 0.09 mg/kg bw/d is determined. The PCPA factor does not apply as no increased sensitivity of the young to the toxic effects of carfentrazone-ethyl was observed.

The ADI proposed is calculated according to the following formula:

$$\text{ADI} = \frac{\text{NOAEL}}{\text{S/UF}} = \frac{9 \text{ mg/kg bw/d}}{100} = 0.09 \text{ mg/kg bw/d}$$

3.3 Determination of Acute Reference Dose

No acute reference dose (ARfD) for carfentrazone-ethyl is required because of its low acute toxicity potential.

3.4 Occupational and Residential Risk Assessment

3.4.1 Toxicological Endpoints

Occupational exposure is expected to be primarily via the dermal route. Inhalation exposure accounted for only 3% of the total exposure.

Short-term dermal toxicity data are most relevant to assess possible occupational risk. Adequate dermal toxicity data are available for the technical active. A 21-day dermal toxicity study in rats did not demonstrate any toxic effects at 1000 mg/kg bw/d. No toxicological triggers were identified for carfentrazone-ethyl based on oncogenicity, genotoxicity, teratogenicity, reproductive toxicity or neurotoxicity studies. Therefore, short-term exposure (dermal or inhalation) and short-term risk assessments were not conducted.

For intermediate-term exposure, such as exposure of custom applicators, the NOAEL of 150 mg/kg bw/d established in the 90-day dietary toxicity study in dogs may be used for the risk assessment. Based on the absence of concerns identified above, the target margin of exposure is 100, which is the standard acceptable value considered adequate in the assessment of occupational risk.

3.4.1.1 Dermal Absorption

With the lack of a dermal absorption study, a value of 100% dermal absorption was assumed.

3.4.2 Occupational Exposure and Risk

3.4.2.1 Mixer/Loader/Applicator Exposure and Risk Assessment

Farmers and custom applicators have the potential for exposure to carfentrazone-ethyl during mixing, loading and application during preplant, postemergence and as a burn-down treatment. Exposure to workers mixing, loading and applying Aim EC is expected to be short-term for farmers and intermediate-term for custom applicators. Exposure will occur primarily by the dermal and inhalation routes. Given a short-term risk assessment is not required due to the absence of toxicological triggers, exposure estimates were not derived for farmers. For custom applicators, a crop grouping approach was used to derive exposure estimates using the highest area treated per day for each crop group. The area treated per day for custom applicators ranged from 16 to 300 hectares per day using groundboom application equipment. Application rates range from 36.5 to 423 mL Aim EC/ha (8.76–101.5 g carfentrazone/ha).

Exposure estimates for mixers, loaders and applicators are based on data from the Pesticide Handlers Exposure Database (PHED) Version 1.1. The PHED is a compilation of generic mixer/loader/applicator passive dosimetry data with associated software that helps generate scenario-specific exposure estimates. Appropriate subsets of A and B grade data (high confidence) were created from the database files of PHED for liquid open mixing/loading, and for groundboom application. All data were normalized for the kilogram of active ingredient handled. Exposure estimates are presented on the basis of the best-fit measure of central tendency, i.e. summing the measure of central tendency for each body part that is most appropriate to the distribution of data for that body part.

The exposure estimates are based on mixer/loaders wearing a single layer of clothing (long pants and long sleeved shirt) plus gloves and applicators wearing a single layer and no gloves.

Dermal exposure was estimated by coupling the unit exposure values with the amount of product handled per day and the dermal absorption value. Inhalation exposure was estimated by coupling the unit exposure values with the amount of product handled per day with 100% inhalation absorption. Exposure was normalized to mg/kg bw/d by using 70 kg adult body weight.

Table 3.4.2.1 Mixer/Loader/Applicator Exposure Summary

Scenario	Application rate (g a.i./ha)	ATPD (ha/day)	Amount of a.i. handled per day (kg a.i./day) [1]	Combined Daily Exposure (µg a.i./kg bw/d)[2]	MOE [3]
Custom Mixing/Loading	8.76–101.5	16–300	0.45–30.45	0.328–22.25	456 995–6743
Custom Application				0.212–14.35	708 633–10 456

1 Amount of a.i. handled per day was calculated using the application rate × area treated per day (ATPD)

2 Daily exposure was calculated using amount of a.i. handled per day × PHED unit exposure value/body weight (70 kg); a default value of 100% dermal absorption was used.

3 Exposure estimates for custom mixing/loading and custom applicator (intermediate term) were compared to a NOAEL of 150 mg/kg bw/d established in the 90-day dietary toxicity in dogs, target MOE = 100.

Margins of exposure for custom applicators that mix/load or apply (intermediate-term exposure duration) were compared to a NOAEL of 150 mg/kg bw/d from a 90-day dietary toxicity study in dogs. All margins of exposure (MOE) exceed the target MOE of 100 and are considered to be acceptable.

3.4.2.2 Exposure and Risk Assessment for Workers Entering Treated Areas

Postapplication exposure to Aim EC is expected to be minimal since the product is applied directly to the ground mainly using a hooded sprayer or sprayed directly onto fields before the crop has been planted. Residues on the leaves are expected to be negligible. The only time Aim EC is applied to the crop directly is as a harvest aid treatment to desiccate the crop. These crops (soybeans, small grains, dry beans, dry peas, potatoes) are all mechanically harvested, so post-application worker exposure is expected to be negligible.

Furthermore, no toxicology triggers were identified for short-term duration risk assessments.

3.4.3 Residential Exposure and Risk Assessment

3.4.3.1 Handler Exposure and Risk

There are no carfentrazone-ethyl domestic class products; therefore, a residential handler exposure assessment is not required.

3.4.3.2 Postapplication Exposure and Risk

There are no carfentrazone-ethyl domestic class products; therefore, a postapplication residential exposure assessment is not required.

3.4.3.3 Bystander Exposure and Risk

Bystander exposure should be negligible because Aim EC is to be applied to agricultural crops only when wind speeds do not exceed 8 km/hour. Therefore, the potential for drift to areas of human habitation or areas in which human activity occurs, such as houses, cottages, schools and recreational areas, is expected to be minimal. The product is to be applied to the ground, on crops as a harvest aid treatment or before the crop has been planted, which should result in negligible residues on the crop and on the foliage. Bystander exposure that may occur during a pick-your-own activity will be negligible as a result.

3.4.4 Aggregate Exposure and Risk Assessment

An aggregate exposure and risk assessment is not required for Aim EC. No acute reference dose was identified for carfentrazone-ethyl. Residential postapplication exposure to Aim EC (i.e. pick-your-own operations) is expected to be minimal since this product is to be applied to the ground, to crops as a harvest aid treatment or before the crop has been planted which would result in negligible residues on foliage.

3.5 Food Residues Exposure Assessment

3.5.1 Residues in Plant and Animal Foodstuffs

For enforcement purposes in plant products, the residue definition is carfentrazone-ethyl and the metabolite F8426-Cl-PAc. For risk assessment purposes in plants, the residue definition is carfentrazone-ethyl and metabolites F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, 3-OH-F8426-BAc, F8426-BAc and Me-3-OH-F8426-BAc. The residue definition for enforcement and risk assessment in animal commodities is carfentrazone-ethyl and the metabolite F8426-Cl-PAc.

The data gathering/enforcement analytical methodology (GC/ECD or GC/MS), is valid for the quantification of residues of carfentrazone-ethyl and metabolite F8426-Cl-PAc in numerous crops and ruminant livestock matrices (meat, milk, fat, liver and kidney). The residues of carfentrazone-ethyl and metabolite F8426-Cl-PAc are stable when stored in a freezer at -20°C for a minimum of 10 months. Raw agricultural commodities were processed, but were not further analysed due to the lack of quantifiable residues except for sorghum, where residues concentrated in aspirated grain fractions. Supervised residue trials conducted throughout the United States using end-use products containing carfentrazone-ethyl at the proposed rate and exaggerated rates in or on numerous crops are sufficient to support the proposed maximum residue limits.

3.5.2 Dietary Risk Assessment

A chronic dietary risk assessment was conducted using the Dietary Exposure Evaluation Model (DEEM–FCID™, Version 2.0), which uses updated food consumption data from the United States Department of Agriculture's Continuing Surveys of Food Intakes by Individuals, 1994–1996 and 1998.

3.5.2.1 Chronic Dietary Exposure Results and Characterization

The basic chronic dietary risk assessment was carried out using proposed Canadian MRLs, American tolerances and default processing factors. Estimated environmental concentration (EEC) values for carfentrazone-ethyl in ground water and surface water were determined. The chronic EEC value of 20.5 µg a.i./L (Level I—from groundwater) was used in the analysis. The refined chronic dietary exposure assessment was conducted using Canadian and American median residues and experimental processing factors. The refined chronic dietary exposure from all supported carfentrazone-ethyl food uses for the total population, including infants and children, and all representative population subgroups ranged from 11.8% to 47.7% of the acceptable daily intake (ADI). Aggregate exposure from food and water is considered acceptable and below the level of concern: 12.3% to 48.4% of the ADI for all populations. The highest exposed population subgroup was children 1 to 2 years old.

3.5.2.2 Acute Dietary Exposure Results and Characterization

As acute reference dose (ARfD) toxicological endpoints have not been established for carfentrazone-ethyl, an acute dietary exposure assessment was not conducted.

3.5.3 Aggregate Exposure and Risk

The aggregate risk for carfentrazone-ethyl consists of exposure from food and drinking water sources only. There are no residential uses. Aggregate risks were calculated based on chronic endpoints. There was no acute endpoint identified for the general population, including infants and children.

3.5.4 Proposed Maximum Residue Limits

Table 3.5.4 Proposed Maximum Residue Limits

MRLs (ppm)	Foods
0.8	Milling fractions of barley, buckwheat, millet, oat, rye, triticale and wheat
0.25	Sorghum
0.1	Root and tuber vegetables*, Bulb vegetables*, Leafy vegetables*, Brassica (cole) vegetables*, Legume vegetables*, Fruiting vegetables*, Cucurbit vegetables*, Pome fruits*, Stone fruits*, Berries*, Cereal grains* except rice and sorghum, Oilseeds*, grape, strawberry
0.1	Meat, meat byproducts and fat of cattle, goat, horse and sheep
0.05	Milk

* See Appendix III for all commodities included within the above named crop groups.

For additional information on MRLs in terms of the international situation and trade implications, refer to Appendix II.

The nature of the residues in animal and plant matrices, analytical methodology, field trial data, and the chronic dietary risk estimates are summarized in Tables 5 and 6 in Appendix I.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

Based on its physical-chemical properties (Section 1.2), carfentrazone-ethyl is very soluble in water, is not likely to volatilize from moist soil or water surfaces under field conditions and is not likely to bioaccumulate in organisms. Environmental fate data for carfentrazone-ethyl are summarized in Table 7 in Appendix I.

Carfentrazone-ethyl is relatively labile and dissipates from soil and aquatic systems by hydrolysis and biotransformation. At cooler temperatures the dissipation of carfentrazone-ethyl is slower in all environmental media. Phototransformation is an important route of transformation for carfentrazone-ethyl in water and air but not in soil. Carfentrazone-ethyl is not persistent in soil, but its major transformation products are generally more persistent than the parent compound. Water/sediment studies demonstrated that the majority of the applied radioactivity is preferentially associated with the water. All transformation products were polar and were largely associated with the aqueous phase. There was no evidence of significant accumulation of either parent compound or its transformation products in the sediment.

Laboratory studies on adsorption/desorption and soil column leaching indicate that carfentrazone-ethyl is not mobile. However, its transformation products have a potential to be mobile in a variety of soils. Carfentrazone-ethyl has no potential for leaching but some of its transformation products do. However, a field study detected not only carfentrazone-ethyl but also its transformation products in only the top 10–20 cm deep soil layer. Most probably leaching was offset by transformation processes; therefore, potential for groundwater contamination would be low. Water monitoring data were not available.

4.2 Effects on Non-target Species

An assessment of environmental risk integrates the exposure and ecotoxicology data to estimate the potential for adverse ecological effects. Exposure is reflected in the calculation of initial and cumulative estimated environmental concentrations (EECs) in soil, water and wildlife food sources. These calculations are performed using a range of application rates selected from the supported uses, taking into consideration the maximum number of applications and minimum interval between applications. Cumulative EECs are estimated by further adjusting the sum of the applications for dissipation between applications using the time for 50% decline (DT_{50}) from the appropriate environmental media.

A screening-level risk assessment is initially performed using the EECs for a direct overspray scenario. The environmental risk is characterized using the quotient method. A risk quotient (RQ), which is the ratio of the EEC to the most sensitive endpoint, is determined. The RQ = 1 is the level of concern (LOC). If the screening-level assessment indicates negligible risk (RQ less than 1), then no further assessment is done. However, if the screening-level assessment results in a potential risk (RQ greater than 1), then a refined assessment is undertaken for the organisms of concern. Refinement of the risk assessment takes into consideration more realistic exposure scenarios (e.g. drift to non-target habitats and runoff to water bodies) and may consider different toxicity endpoints.

4.2.1 Effects on Terrestrial Organisms

A risk assessment of carfentrazone-ethyl to terrestrial organisms was based upon an evaluation of toxicity data on carfentrazone-ethyl to earthworms (acute contact), bees (acute oral and chronic), predatory and/or parasitic invertebrates, birds (acute oral, dietary, and chronic), mammals (acute oral, dietary, and chronic) and 10 species of terrestrial plants (seed germination, seedlings emergence and vegetative vigour). A summary of terrestrial toxicity data for carfentrazone-ethyl is presented in Table 8 in Appendix I. For the assessment of risk, toxicity endpoints chosen from the most sensitive species were used as surrogates for the wide range of species that could potentially be exposed following treatment with carfentrazone-ethyl.

Carfentrazone-ethyl demonstrated no adverse toxicological effects on terrestrial invertebrates, birds or mammals on an acute oral, dietary and reproductive basis. As carfentrazone-ethyl is a herbicide, adverse effects to non-target terrestrial plants are expected. Plant emergence and vegetative vigour studies conducted with ten plant species indicated that, although the seeds of most plant species emerged successfully, plants did not follow normal growth patterns due to the ability of carfentrazone-ethyl to inhibit the plant enzyme, protoporphyrinogen oxidase. This action results in membrane disruption, which ultimately kills sensitive weeds by interfering with the chlorophyll biosynthetic pathway. Symptoms of carfentrazone-ethyl toxicity were mainly manifest as retarded growth with some necrosis. No toxicity studies conducted with carfentrazone-ethyl transformation products were available for review.

The screening level risk assessment indicated that exposure to carfentrazone-ethyl does not pose a risk to terrestrial invertebrates, mammals and birds. Appendix I, Table 9 summarizes the risk assessment from carfentrazone-ethyl to terrestrial organisms.

As would be expected, the herbicide carfentrazone-ethyl poses a risk to non-target terrestrial plants. The level of concern (LOC) was exceeded by as much as 84 times. Less than 0.012% of the carfentrazone-ethyl maximum application rate (84 g a.i./ha) is expected to negatively affect non-target terrestrial plants (EC_{25} divided by the application rate). As a result, a refinement of the risk assessment was conducted taking into consideration the concentrations of carfentrazone ethyl that could be present in terrestrial habitat directly adjacent to the application field through drift of spray. Spray drift data for a medium American Society of Agricultural Engineers (ASAE) droplet size, as is generally used in groundboom applications of herbicides, indicate that the maximum amount of spray that will drift one metre downwind from the point of application during spraying is 6%. Using this percent drift, the off-site EECs for carfentrazone-

ethyl were calculated. Based on this method of refinement, carfentrazone-ethyl poses a reduced risk to non-target terrestrial plants directly adjacent to the application field. Exceedance of the LOC was reduced to 5 times from 84 times. Buffer zones will be required to mitigate the risk of carfentrazone-ethyl to non-target terrestrial plants. Appendix I, Table 10 summarizes the refined risk assessment from carfentrazone-ethyl to non-target terrestrial plants.

4.2.2 Effects on Aquatic Organisms

Risk to aquatic organisms, acute and chronic, is based on an evaluation of toxicity data on carfentrazone-ethyl for eight freshwater species (one invertebrate, two fish, two algae, one diatom, and one vascular plant) and four estuarine/marine species (two invertebrates, one fish and one alga). Some toxicity data on the transformation products were also available. A summary of aquatic toxicity data for carfentrazone-ethyl and its transformation products is presented in Appendix I, Table 8. For the assessment of risk, toxicity endpoints chosen from the most sensitive species were used as surrogates for the wide range of species that can be potentially exposed following treatment with carfentrazone-ethyl.

Carfentrazone-ethyl and its transformation products are not toxic to freshwater and marine invertebrates and fish on an acute bases. Chronic effects to freshwater fish and invertebrates are not expected. No chronic toxicity data were available for estuarine/marine species. As carfentrazone-ethyl is a herbicide, adverse effects to non-target aquatic plants are expected. Carfentrazone-ethyl affected biomass and cell density of freshwater and marine/estuarine algae. Carfentrazone-ethyl affected frond density and biomass of duckweed. The transformation products did not adversely affect algae or duckweed at the maximum concentrations tested.

The risk assessment was conducted using data for the most sensitive freshwater organisms tested *Daphnia magna*, rainbow trout (*Oncorhynchus mykiss*), diatom (*Navicula pelliculosa*) and duckweed (*Lemna gibba)* as well as marine/estuarine algae *(Skeletonema costatum)*.

The screening level risk assessment indicated that carfentrazone-ethyl does not pose a risk to freshwater invertebrates and fish. However, a potential risk to amphibians (based on surrogate data from fish studies), algae and vascular plants was identified at the maximum application rate. The LOC was exceeded by 3.6 times at the highest application rate of 84 g a.i./ha. Thus, a refined risk assessment was triggered which reduced the exceedance of the LOC to less then 1 from spray drift, however, there is a potential risk from runoff to freshwater algae and vascular plants (LOC exceeded by 2.36 times). There are label statements to mitigate the risk of carfentrazone-ethyl to non-target aquatic plants from run-off. Appendix I, Table 11 summarizes risk assessment from carfentrazone-ethyl to aquatic organisms. Appendix I, Tables 12 and 13 summarize refined risk to aquatic organisms from carfentrazone-ethyl spray drift and runoff, respectively. As monitoring data were not available, they were not considered in the risk assessment.

5.0 Value

5.1 Aim EC

Efficacy data were submitted from 1010 replicated field trials conducted over a 17-year period (1988 to 2004) at several locations in Iowa, Idaho, Illinois, Indiana, Massachusetts, Michigan, Missouri, Montana, North Dakota, Nebraska, New York, Ohio, Oregon, Pennsylvania, South Dakota, Washington, Wisconsin and Wyoming. Treatments testing various rates were included to determine the lowest effective rate. The herbicide treatments were applied using small plot application equipment.

The efficacy of Aim EC was visually assessed as a percent weed control and then compared to an untreated weedy check. Observations were taken up to three times during the growing season.

5.1.1 Acceptable Efficacy Claims for Aim EC

The submitted efficacy data established the lowest effective rate for Aim EC applied alone, either as a preplant burndown application or as a hooded application. The data support the weed control claims summarized in Table 5.1.1.

Table 5.1.1 Weed Control Claims for Aim EC

Aim EC Herbicide Rate	Weeds Controlled
8.76 g a.i./ha (36.5 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	Lamb's quarters (up to 7.5 cm tall), morning glory (up to 3 leaves), Eastern black nightshade, redroot pigweed, velvetleaf, tall waterhemp (up to 5 cm tall)
13.92 g a.i./ha (58 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	All the weeds controlled at 36.5 mL product/ha plus: lamb's quarters, round-leaved mallow, morning glory, hairy nightshade, field pennycress, prostrate pigweed, smooth pigweed, tumble pigweed, common purslane, Pennsylvania smartweed (seedling), tansy mustard, tall waterhemp
17.52 g a.i./ha (73 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	All the weeds controlled at 58 mL product/ha plus: carpetweed, cocklebur, jimsonweed, kochia, Eastern black nightshade, volunteer canola, glyphosate tolerant volunteer canola

Aim EC Herbicide Rate	Weeds Controlled
28 g a.i./ha (117 mL product/ha) + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	All the weeds controlled at 73 mL product/ha plus: burclover, prickly lettuce, Venice mallow (up to 5 cm tall), corn spurry

Note: Control of the listed weeds up to ten (10) cm in height or as specified.

5.1.2 Herbicide Tank Mix Combinations

5.1.2.1 Aim EC Plus Roundup Ultra Liquid Herbicide or Roundup Ultra Max Liquid Herbicide or Roundup Weathermax with Transorb 2 Technology Liquid Herbicide or Nufarm Credit Liquid Herbicide or Credit Plus Liquid Herbicide

The submitted efficacy data support the weed control claims summarized in Table 5.1.2.1 for a tank mix of Aim EC plus Roundup Ultra Liquid Herbicide or Roundup Ultra Max Liquid Herbicide or Roundup Weathermax with Transorb 2 Technology Liquid Herbicide or Nufarm Credit Liquid Herbicide or Credit Plus Liquid Herbicide as a preplant burndown application or in a fallow system.

The efficacy data submitted did not indicate the product name for glyphosate products, i.e. only the term glyphosate was used in all reports. Therefore, supplementary data are required to support all the glyphosate product tank-mix options listed above.

Table 5.1.2.1 Weed Control Claims for Aim EC plus Roundup Ultra Liquid Herbicide or Roundup Ultra Max Liquid Herbicide or Roundup Weathermax with Transorb 2 Technology Liquid Herbicide or Nufarm Credit Liquid Herbicide or Credit Plus Liquid Herbicide

Herbicide Rate	Weeds Controlled
8.76 to 17.52 g a.i./ha (36.5 to 73 mL product/ha) of Aim EC + 450 to 900 g a.i./ha of glyphosate + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	Common dandelion, kochia, horsetail, field pennycress, Pennsylvania smartweed, Russian thistle, chickweed, common lamb's quarters, morning glory, shepherd's purse, tansy mustard, volunteer canola, glyphosate tolerant volunteer canola

5.1.2.2 Aim EC Plus 2,4-D Ester

The submitted efficacy data support the weed control claims summarized in Table 5.1.2.2 for a tank mix of Aim EC plus 2,4-D ester as a preplant burndown application or in a fallow system.

Table 5.1.2.2 Weed Control Claims for Aim EC plus 2,4-D Ester

Herbicide Rate	Weeds Controlled
8.76 to 17.52 g a.i./ha (36.5 to 73 mL product/ha) of Aim EC + 560 g a.i./ha of 2,4-D ester + Agral 90 or Ag-Surf at 0.25% v/v or Merge at 1% v/v	Wild buckwheat, kochia, prickly lettuce, common lamb's quarters, horsetail, Russian thistle, morning glory, field pennycress, shepherd's purse, Pennsylvania smartweed, tansy mustard, volunteer canola, glyphosate tolerant volunteer canola

5.2 Phytotoxicity to Host Plants

As Aim EC is not to be applied as a broadcast treatment after crops have emerged and has no soil activity, an assessment of crop tolerance was not necessary.

5.2.1 Acceptable Crops for Preplant Burndown Application

Aim EC can be applied in a fallow system or as a preplant burndown to control all labelled weeds in the following crop groups.

Crop Subgroup 6: Succulent or dried legume vegetable (beans (*Lupinus* spp. includes grain lupin, sweet lupin, white lupin, and white sweet lupin; *Phaseolus* spp. includes field bean, kidney bean, lima bean (dry), navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean; *Vigna* spp. includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, Crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean; chickpea; lentil; pea (*Pisum* spp. includes dwarf pea, edible-pod pea, English pea, field pea, garden pea, green pea, snow pea, sugar snap pea); soybean)

Crop Group 8: Fruiting Vegetables (Except Cucurbits) transplanted only, (eggplant; groundcherry; pepino; pepper (includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper); tomatillo; tomato)

Crop Group 9: Cucurbit Vegetables, transplanted only, (citron melon; cucumber; gherkin; *Momordica* spp. (includes bitter melon, Chinese cucumber); muskmelon (includes true cantaloupe, cantaloupe, casaba melon, crenshaw melon, golden pershaw melon, honeydew melon, honey ball melon, mango melon, Persian melon, pineapple melon, Santa Claus melon, snake melon); pumpkin; squash, summer (includes crookneck squash, scallop squash, straightneck squash, vegetable marrow, zucchini); squash, winter (includes butternut squash, calabaza, hubbard squash, acorn squash, spaghetti squash); watermelon (includes hybrids and/or varieties of *Citrullus lanatus*))

Crop Group 15: Cereal Grains (barley; buckwheat; corn (includes sweet corn and field corn); millet, pearl; millet, proso; oats; popcorn; rye; sorghum (maximum of 73 mL of product per hectare); teosinte; triticale; wheat)

Crop Group 20: Oilseeds (rape seed; rape seed, Indian; mustard seed, Indian; mustard seed, Field; mustard seed; flax; sunflower; safflower)

5.2.2 Acceptable Crops for Hooded Sprayer Application

Aim EC may be applied with hooded sprayers to control all labelled weeds between the rows of the following crops.

Crop Group 1: Root and Tuber Vegetables (Chinese artichoke; Jerusalem artichoke; garden beet; sugar beet; edible Burdock; carrot; celeriac; turnip-rooted chervil; chicory; ginseng; horseradish; turnip-rotted parsley; parsnip; potato; radish; oriental radish; rutabaga; salsify; black salsify; Spanish salsify; sweet potato; turnip)

Crop Group 3: Bulb Vegetables (garlic; great-headed garlic; leek; dry bulb onion; green onion; Welch onion; shallot)

Crop Group 4: Leafy Vegetables (Except Brassica Vegetables) (arugula; celery; Chinese celery; edible-leaved chrysanthemum; garland chrysanthemum; corn salad; garden cress; upland cress; dock; endive; Florence fennel; head lettuce; leaf lettuce; parsley; garden purslane; winter purslane; radicchio; rhubarb; spinach; Swiss chard)

Crop Group 5: Brassica (Cole) Leafy Vegetables (broccoli; Chinese broccoli; raab broccoli; Brussels sprouts; cabbage; Chinese cabbage (bok choy); Chinese cabbage (napa); Chinese mustard cabbage, cauliflower; cavalo broccolo; collards; kale; kohlrabi; mizuna; mustard greens; mustard spinach; rape greens)

Crop Subgroup 6: Succulent or dried legume vegetable (beans (*Lupinus* spp. includes grain lupin, sweet lupin, white lupin, and white sweet lupin; *Phaseolus* spp. includes field bean, kidney bean, lima bean (dry), navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean; *Vigna* spp. includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, Crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean; chickpea; lentil; pea (*Pisum* spp. includes dwarf pea, edible-pod pea, English pea, field pea, garden pea, green pea, snow pea, sugar snap pea); soybean)

Crop Group 8: Fruiting Vegetables (Except Cucurbits) transplanted only, (eggplant; groundcherry; pepino; pepper (includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper); tomatillo; tomato)

Crop Group 9: Cucurbit Vegetables, transplanted only, (citron melon; cucumber; gherkin; *Momordica* spp. (includes bitter melon, Chinese cucumber); muskmelon (includes true cantaloupe, cantaloupe, casaba melon, crenshaw melon, golden pershaw melon, honeydew melon, honey ball melon, mango melon, Persian melon, pineapple melon, Santa Claus melon, snake melon); pumpkin; squash, summer (includes crookneck squash, scallop squash, straightneck squash, vegetable marrow, zucchini); squash, winter

(includes butternut squash, calabaza, hubbard squash, acorn squash, spaghetti squash); watermelon (includes hybrids and/or varieties of *Citrullus lanatus*))

Crop Group 11: Pome Fruits (apple; crabapple; mayhaw; pear; pear, oriental; quince)

Crop Group 12: Stone Fruits (apricot; sweet cherry; tart cherry; nectarine; peach; plum; Chickasaw plum; Damson plum; Japanese plum; plumcot; prune (fresh))

Crop Group 13: Berries (blackberry includes bingleberry, black satin berry, boysenberry, Cherokee blackberry, Chesterberry, Cheyenne blackberry, coryberry, darrowberry; dewberry, Dickson thornless berry, Himalayaberry, hullberry, Lavacaberry, lowberry, Lucretiaberry, mommoth blackberry, marionberry, nectarberry, olallieberry, Oregon evergreen berry, phenomenalberry, rangeberry, ravenberry, rossberry, Shawnee blackberry, youngberry, and varieties and/or hybrids of these); blueberry; currant; elderberry; gooseberry; huckleberry; loganberry; raspberry, black and red)

5.2.3 Acceptable Crops for Harvest Aid Treatment

Aim EC may be applied as a harvest aid treatment to the following crops at the rate of 73 to 117 mL of product per hectare (17.52 to 28 g a.i./ha), except for sorghum where the maximum rate is 73 mL of product (17.52 g a.i./ha per ha) and for potatoes where the maximum rate is 350 mL of product per hectare (84 g a.i./ha).

Potatoes, soybeans, barley, millet, oats, sorghum, triticale, wheat and Crop Subgroup 6-C: Dried shelled pea and bean (except soybean): (dried cultivars of bean (*Lupinus* spp. includes grain lupin, sweet lupin, white lupin, and white sweet lupin; *Phaseolus* spp. includes field bean, kidney bean, lima bean (dry), navy bean, pinto bean, tepary bean, bean; *Vigna* spp. includes adzuki bean, blackeyed pea, catjang, cowpea, Crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean); broad bean (dry); chickpea; lentil; pea (*Pisum* spp. includes field pea)).

5.3 Impact on Succeeding Crops

A rationale to address rotational crops was submitted in lieu of data to support the labelled rotational claims. As demonstrated by field dissipation studies the rationale was acceptable because carfentrazone-ethyl is only absorbed by the foliage of plants, breaks down rapidly in the environment and has a half-life of only a few days.

5.3.1 Acceptable Claims for Rotational Crops for Carfentrazone-ethyl

The rationale provided to address rotational crops supports the claim that all crops may be planted 12 months following an application of carfentrazone-ethyl.

5.4 Economics

No market analysis was conducted or reviewed for carfentrazone-ethyl.

5.5 Sustainability

5.5.1 Survey of Alternatives

No survey of alternatives was conducted for carfentrazone-ethyl.

5.5.2 Compatibility with Current Management Practices Including Integrated Pest Management

Carfentrazone-ethyl offers broad-spectrum weed control when used as a postemergence herbicide in a preplant burndown application or fallow system or between rows of crops using a hooded sprayer application. Carfentrazone-ethyl is compatible with integrated weed management practices as it controls a range of broadleaf weeds with a single application and because its postemergence application timing determines whether this herbicide is suitable for the particular weed species present in the field. Carfentrazone-ethyl is compatible with conservation tillage and conventional production systems.

5.5.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance

Repeated use of herbicides having the same mode of action in a weed control program increases the probability of selecting naturally resistant biotypes. Therefore, carfentrazone-ethyl should be used in rotation with herbicides having different modes of action.

The Aim EC label includes the resistance management statements, as per Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*.

6.0 Pest Control Product Policy Considerations

6.1 Toxic Substances Management Policy Considerations

The management of toxic substances is guided by the federal government's Toxic Substances Management Policy, which puts forward a preventive and precautionary approach to deal with substances that enter the environment and could harm the environment or human health. The policy provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. One of the key management objectives is virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These substances are referred to in the policy as Track 1 substances.

During the review process, carfentrazone-ethyl was assessed in accordance with the PMRA Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*. Substances associated with the use of carfentrazone-ethyl were also considered, including major transformation products formed in the environment, microcontaminants in the technical product and formulants in the end-use products. The PMRA has reached the following conclusions.

- Carfentrazone-ethyl is not bioaccumulative. The log *n*-octanol–water partition coefficient (log K_{ow}) of carfentrazone-ethyl is 3.36, which is below the Toxic Substances Management Policy (TSMP) Track 1 cut-off criterion for log $K_{ow} \geq 5.0$.

- Carfentrazone-ethyl does not meet the criteria for persistence. The half-life values in water (0.1–1.3 days) and soil (1 day) are below the TSMP Track 1 cut-off criteria for water (≥ 182 days), sediment (≥ 182 days) and soil (≥ 182 days).

Therefore, the use of carfentrazone-ethyl is not expected to result in the entry of Track 1 substances into the environment.

6.2 Formulants and Contaminants of Health or Environmental Concern

- Technical grade carfentrazone-ethyl does not contain any contaminants of health or environmental concern identified in the *Canada Gazette*, Part II, Volume 139, Number 24, pages 2641-2643: List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern.

- The end-use product, Aim EC, does not contain any formulants of health or environmental concern identified in the *Canada Gazette*, Part II, Volume 139, Number 24, pages 2641-2643: List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern.

7.0 Summary

7.1 Human Health and Safety

The toxicology database submitted for carfentrazone-ethyl is adequate to define the toxic effects that may result from human exposure. In short- and long-term toxicity studies in laboratory animals, carfentrazone-ethyl caused systemic toxicity at high dose levels and organ toxicity associated with metabolism and detoxification of orally administered carfentrazone-ethyl. Observed systemic toxicity at high doses included effects on food consumption, body weight and body-weight gain. Organ toxicity invariably involved the liver and the kidneys. One other notable observation was the effect of carfentrazone-ethyl on porphyrin metabolism, which resulted in increased urinary excretion of various porphyrin components. There was no evidence of other toxic effects, including carcinogenicity, mutagenicity, teratogenicity, neurotoxicity, reproductive toxicity or increased susceptibility of the young.

Farmers and custom applicators who mix, load or apply Aim EC and workers reentering treated fields are not expected to be exposed to levels of carfentrazone-ethyl that will result in an unacceptable risk when Aim EC is used according to label directions. The personal protective equipment on the product label is adequate to protect workers.

The nature of the residue in plants and animals is adequately understood. The residue definition for enforcement purposes in plant products is carfentrazone-ethyl and metabolite F8426-Cl-PAc and for risk assessment purposes, the residue definition in plants is carfentrazone-ethyl and metabolites F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, 3-OH-F8426-BAc, F8426-BAc and Me-3-OH-F8426-BAc.

The residue definition for enforcement and risk assessment in animal commodities is carfentrazone-ethyl and metabolite F8426-Cl-PAc. The proposed use of carfentrazone-ethyl on crops does not constitute an unacceptable chronic dietary risk (in food and drinking water) to any segment of the population, including infants, children, adults and seniors. Sufficient crop residue data have been reviewed to recommend maximum residue limits to protect human health.

7.2 Environmental Risk

Carfentrazone-ethyl is non-persistent in most soils and water systems, although its transformation products are more persistent than the parent compound. There is a potential that carfentrazone-ethyl may appear in surface water through runoff. The risk assessment of carfentrazone-ethyl indicates there is a potential for adverse effects on non-target terrestrial and aquatic plants. To reduce the effects of carfentrazone-ethyl in the environment, mitigation in the form of precautionary label statements and buffer zones are required. Carfentrazone-ethyl presents negligible risk to wild birds and mammals, bees and other arthropods as well as to aquatic organisms like fish, amphibians and invertebrates.

7.3 Value

The data submitted to register Aim EC are adequate to describe its efficacy for use as a preplant burndown application for numerous crops in a fallow system, between the rows of a wide range of crops or as a harvest aid treatment. A single postemergence application of Aim EC provides control of several broadleaf weeds.

Confirmatory data are required to support the tank mix options of Roundup Ultra Liquid Herbicide, Roundup Ultra Max Liquid Herbicide, Roundup Weathermax with Transorb 2 Technology Liquid Herbicide, Nufarm Credit Liquid Herbicide and Credit Plus Liquid Herbicide when applied as a preplant burndown treatment or in a fallow system.

8.0 Regulatory Decision

Health Canada's PMRA, under the authority of the PCPA and in accordance with the Pest Control Products Regulations, has granted conditional registration for the sale and use of Aim (Carfentrazone-ethyl) Technical Herbicide and the end-use product Aim EC to control weeds in numerous crops.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

Although the risks and value have been determined to be acceptable when all risk reduction measures are followed, as a condition of these registrations, additional scientific information is required as a result of this evaluation. For more details, refer to the Section 12 Notice associated with these conditional registrations.

Value

Confirmatory data are required to support the list of glyphosate tank mix partners which can be tank mixed with Aim EC in preplant burndown or fallow system applications.

NOTE: The PMRA will publish a Consultation Document when there is a proposed decision on applications to convert these conditional registrations to full registrations or on applications to renew the conditional registrations, whichever occurs first.

List of Abbreviations

µg	microgram(s)
°C	degree(s) Celsius
a.i.	active ingredient
AD	administered dose
ADI	acceptable daily intake
ARfD	acute reference dose
ASAE	American Society of Agricultural Engineers
bw	body weight
cm	centimetre(s)
d	day(s)
DAT	day(s) after treatment
DNA	deoxyribonucleic acid
DT_{50}	dissipation time to 50% (the dose required to observe a 50% decline in the test population)
EC_{25}	exposure concentration to 25% (a concentration causing 25% adverse effects in the test population
EC_{50}	exposure concentration to 50% (a concentration causing 50% adverse effects in the test population
EEC	expected environmental concentration
F_2	second filial generation
g	gram(s)
GC/ECD	gas chromatography with electron capture detection
GC/MS	gas chromatography with mass spectrometry detection
h	hour(s)
ha	hectare(s)
HAFT	highest average field test
HDT	highest dose tested
Hg	mercury
HPLC	high performance liquid chromatography
kg	kilogram(s)
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
LC_{50}	lethal concentration to 50% (a concentration causing 50% mortality in the test population
LD_{50}	lethal dose to 50% (a dose causing 50% mortality in the test population)
L	litre(s)
LOAEL	lowest observed adverse effect level
LOC	level of concern
LOD	level of detection
LOQ	level of quantitation
MAS	maximum average score
mg	milligram(s)
mL	millilitre(s)
mm	millimetre(s)
MOE	margin of exposure

MRL	maximum residue limit
nm	nanometre(s)
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOEL	no observed effect level
OC	organic carbon
OM	organic matter
Pa	pascal(s)
PCPA	*Pest Control Products Act*
pH	-log10 hydrogen ion concentration
PHED	Pesticide Handlers Exposure Database
PHI	post harvest interval
PMRA	Pest Management Regulatory Agency
ppb	parts per billion
ppm	parts per million
RAC	raw agricultural commodities
RQ	risk quotient
TRR	total radioactive residues
TSMP	Toxic Substances Management Policy
v/v	volume per volume dilution

Appendix I Tables and Figures

Table 1 Residue Analysis

Matrix	Method ID	Analyte	Method Type	LOQ	Reference
Plant	Report No. P-3041	Carfentrazone-ethyl	GC/ECD	0.05 ppm in plant matrices	1151402, 1265789
		F8426-Cl-PAc	GC/MS	0.05 ppm in plant matrices	
	Report No. P-3263	Carfentrazone-ethyl	GC/ECD	0.05 ppm in plant matrices	1151357, 1282646
		F8426-Cl-PAc	GC/MS	0.05 ppm in plant matrices	
Animal	Report No. P-3151	Carfentrazone-ethyl F8426-Cl-PAc	GC/ECD	0.025 ppm in milk 0.05 ppm in animal tissues	1151333, 1151356, 1282646
Soil		Carfentrazone-ethyl (F8426)	GC/MSD	5 ppb	1150771
		F8426- Cl-PAc			
		F8426-CAc			
		F8426-PAc			
		F8426-BAc			
		3-OH-F8426-BAc			
Sediment	The method submitted for soil was extended to sediment.				
Water	The method was not provided for determination of parent and residues in water.				

Table 2 Acute Toxicity of The Associated End-use Product (AIM 240 g/L EC and AIM 240 g/L EW Herbicide)

Study Type	Species	Result	Comment
Acute Toxicity of Aim (Carfentrazone-ethyl)Technical Herbicide			
Oral	Rat	LD_{50} > 5000 mg/kg bw	LOW TOXICITY
Dermal	Rat	LD_{50} > 4000 mg/kg bw	LOW TOXICITY
Inhalation	Rat	LC_{50} > 5.09 mg/L (nominal = 9.04 mg/L)	LOW TOXICITY
Skin irritation	Rabbit	MAS[a] = 0	Non-irritating
Eye irritation	Rabbit	Maximum irritation score = 7.3/110 at 1 h	Minimally irritating
Skin sensitization (Buehler)	Guinea pig	Negative	Not a skin sensitizer
Acute Toxicity of End-Use Product - Aim EC and AIM 240 g/L EW Herbicide			
Oral	Rat	LD_{50} > 4000 mg/kg bw	LOW TOXICITY
Dermal	Rat	LD_{50} > 4000 mg/kg bw	LOW TOXICITY
Inhalation	Rat	LC_{50} > 6.31 mg/L (nominal = 8.35 mg/L)	LOW TOXICITY
Skin irritation	Rabbit	MAS = 1.6/8	Minimally irritating CAUTION SKIN IRRITANT
Eye irritation	Rabbit	MAS = 13.5/110	Minimally irritating CAUTION EYE IRRITANT
Skin sensitization (Buehler)	Guinea pig	Negative	Not a skin sensitizer

[a] MAS = maximum average score for 24, 48 and 72 hours

Table 3 Toxicity Profile of Aim (carfentrazone-ethyl) Technical Herbicide

Study Type	Species	Results[a] (mg/kg/d)
7-14-Day oral (dietary and capsule)	Dog	Concluded that administration of carfentrazone-ethyl in the diet was not recommended.
28-Day dietary	Rat	NOAEL: ♂ = 74.6, ♀ = 85.2 LOAEL: ♂ = 293, ♀ = 330; based on liver and kidney pathology
28-Day oral (capsule)	Dog	This is a range finding study
90-Day dietary	Mouse	NOAEL: ♂♀ ~571 LOAEL: ♂♀ ~1143; based on liver pathology
90-Day dietary	Rat	NOAEL: ♂ = 226, ♀ = 284 LOAEL: ♂ = 470, ♀ = 578; based on body weight, clinical chemistry, liver and kidney pathology
90-Day oral (capsule)	Dog	NOAEL: 150 LOAEL: 500; based on body weight and urinary porphyrin
1-Year oral (capsule)	Dog	NOAEL: 150 LOAEL: 500; based on body weight and urinary porphyrin
21-Day dermal	Rat	NOAEL: 1000 (HDT)
Oncogenicity (18-month dietary)	Mouse	NOAEL: ♂ = 10, ♀ = 12 LOAEL: ♂ = 110, ♀ = 119 based on liver pathology; no evidence of oncogenic potential
Chronic toxicity / oncogenicity (2-year dietary)	Rat	NOAEL: ♂ = 9, ♀ = 12 LOAEL: ♂ = 37, ♀ = 49; based on porphyrin deposit in liver; no evidence of oncogenic potential
2-generation reproduction	Rat	NOAELs: parental systemic: ♂ = 120, ♀ = 137 offspring: ♂ = 120, ♀ = 137 reproductive: ♂ = 323, ♀ = 365 LOAELs: parental systemic: ♂ = 323, ♀ = 365; based on body weight and liver pathology offspring: ♂ = 323, ♀ = 365; based on ↓ body weight of F_2 pups reproductive: ♂ >323, ♀ >365 No evidence of reproductive toxicity
Developmental toxicity	Rat	NOAELs: parental systemic: 100 developmental: 1250 LOAELs: parental systemic: 600; based on clinical signs developmental: >1250 No evidence of teratogenicity

Study Type	Species	Results[a] (mg/kg/d)
Developmental toxicity	Rabbit	NOAELs: parental systemic: 150 developmental: 300 LOAELs: parental systemic: 300; based on clinical signs developmental: >300 No evidence of teratogenicity
Acute neurotoxicity	Rat	NOAELs: systemic = 500; neurotoxicity = 2000 LOAELs: systemic = 2000; neurotoxicity >2000
90-Day neurotoxicity	Rat	NOAELs: systemic ♂ = 59, ♀ = 71; neurotoxicity ♂ = 1178, ♀ = 1434 LOAELs: systemic ♂ = 1178, ♀ = 1434; neurotoxicity >1178
Ames gene mutation assay (2 studies)	*Salmonella typhimurium / E.coli*	Negative
In vitro gene mutation CHO/HGPRT assay	Chinese hamster ovary cells	Negative
In vitro mammalian chromosomal aberration	Chinese hamster ovary cells	Positive without metabolic activation Negative with metabolic activation
In vitro unscheduled DNA synthesis	Primary rat hepatocytes	Negative
In vivo mammalian cytogenetics	Mouse micro nucleus assay	Negative
Metabolism	Rat	**Absorption:** rapid; plasma T_{max} = 0.8–2.5 h **Distribution**: minimum tissue distribution; no potential to accumulate in tissues. **Excretion**: rapid; ~85% AD excreted within 24 h; >96% AD recovered; urinary excretion—72–87% AD; fecal excretion—10–26% AD **Metabolism:** extensive; <1% parent compound excreted **Metabolites:** F8426-chloropropionic acid, 3-hydroxymethyl-F8426-chloropropionic acid, 3-hydroxymethylpropionic acid and F8426-cinnamic acid

[a] Effects observed in males and females unless otherwise reported.

Table 4 Toxicology Endpoints for Use in Health Risk Assessment for Carfentrazone-ethyl

Exposure Scenario	Dose (mg/kg bw/d)	Study	Endpoint	MOE
Acute dietary, all age groups	ARfD not required because of low acute toxicity			
Chronic Dietary	NOAEL = 9	2-year chronic toxicity and oncogenicity study in rats	No significant endpoints identified	100
	ADI = 0.09 mg/kg bw/d			
Short-term dermal	NOEL = 1000	21-day rat dermal toxicity	Absence of toxic effects	100
Intermediate-term dermal	NOAEL = 150	90-day and 1-year dog oral	Body weight and urinary porphyrin	100

Figure 1 Proposed Metabolic Scheme in the Rat

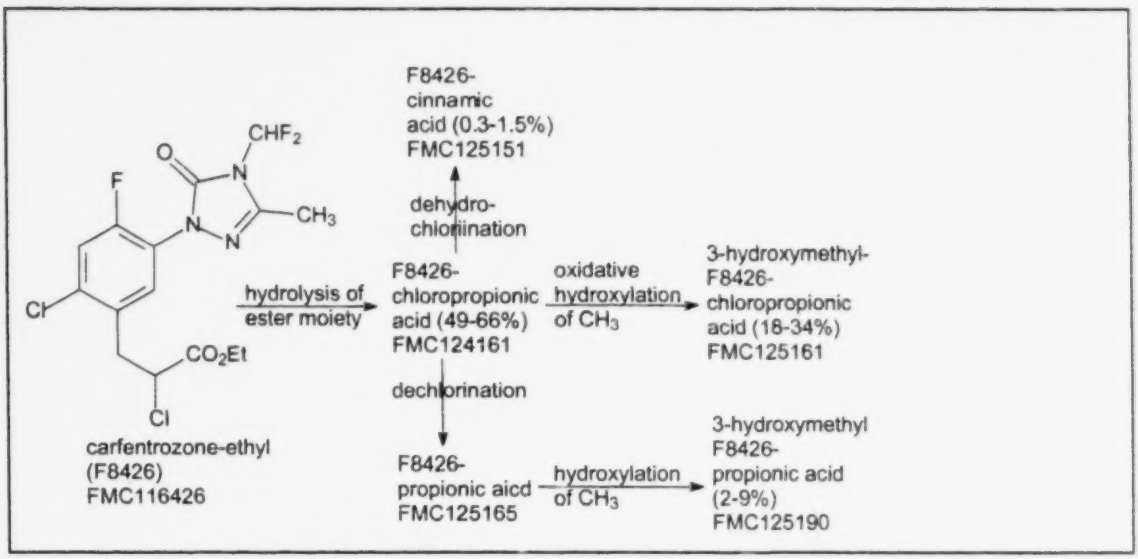


Table 5 Integrated Food Residue Chemistry Summary

NATURE OF THE RESIDUE IN PLANTS IN CORN, Field		PMRA # 1151312, 1265789
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Test site	Greenhouse	
Treatment	Applied foliarly to corn plants with 4 to 6 leaves	
Rate	69 or 140 g a.i./ha	69 or 140 g a.i./ha
End-use product	Not indicated in the review.	
Preharvest interval	Foliage was harvested 42 or 54 days after treatment (DAT), silage was harvested 61 or 75 DAT, and fodder and grain were harvested 76 or 103 DAT.	

For both labels, the majority of the total radioactive residues (TRRs) at the lower treatment rate were in fodder (0.102–0.269 ppm), forage (0.029–0.054 ppm) and silage (0.027–0.056 ppm) compared to grain (0.001–0.002 ppm). The TRRs for both labels at the higher treatment level were 0.756–0.898 ppm in forage, 0.787–0.742 ppm in silage, 0.989–1.085 in fodder and 0.002–0.004 ppm in grain.

As TRRs in grain were low, no further characterization or identification of residues was conducted. Forage, silage and fodder samples from both treatments were extracted with methanol:water and analysed by HPLC. The extracts from the high treatment rate samples were partitioned with dichloromethane. The organic fraction was analysed by HPLC and the aqueous fraction was subject to acid hydrolysis prior to analysis by HPLC.

The post extraction solids (PES) of the silage and fodder samples from the methanol:water extracts were subject to sequential hydrolysis with weak acid, cellulase, ∝-amylase and protease each releasing 1 to 6% of the TRRs.

Metabolites Identified	**Major Metabolites (> 10% TRRs)**		**Minor Metabolites (< 10% TRRs)**	
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Corn, forage	carfentrazone-ethyl (F8426), 3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, 3-DM-F8426-Cl-PAc	F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, F8426-∝-sulfo-PAc	3-OH-F8426-Cl-PAc, F8426-∝-sulfo-PAc
Corn, silage	3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, 3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, F8426-∝-sulfo-PAc	3-OH-F8426-Cl-PAc, F8426-∝-sulfo-PAc
Corn, fodder	3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, 3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, F8426-∝-sulfo-PAc	3-OH-F8426-Cl-PAc, F8426-∝-sulfo-PAc

NATURE OF THE RESIDUE IN PLANTS IN RADISH			PMRA # 1151405, 1184604	
Radiolabel Position	**[Phenyl-U-^{14}C]**		**[Triazole-5-^{14}C]**	
Test site	Greenhouse			
Treatment	Applied foliarly to radish plants at the 3-4 full leaf stage.			
Rate	17 or 67 g a.i./ha		17 or 67 g a.i./ha	
End-use product	Emulsifiable concentrate (EC)			
Preharvest interval	Radish plants were harvested 13 days after treatment.			
For both labels, the majority of the total radioactive residues (TRRs) were in radish leaves (0.150–0.190 ppm) followed by the roots (0.011–0.016 ppm) at the lower treatment rate. At the high treatment rate, TRRs in leaves and roots were 0.607–0.948 ppm and 0.041–0.069 ppm, respectively. Approximately 90–92% of the TRRs were extractable with methanol:water (both labels). The non-extractable residues accounted for 7.7–10.3% of the TRRs.				
Metabolites Identified	**Major Metabolites (> 10% TRRs)**		**Minor Metabolites (< 10% TRRs)**	
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Radish, roots	F8426-Cl-PAc, 3-OH-F8426-Cl-PAc	F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, F8426-BAc, 3-OH-F8426-BAc	F8426, F8426-BAc, 3-OH-F8426-BAc, F8426-CAc	F8426, F8426-CAc
Radish, leaves	F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, 3-OH-F8426-BAc	F8426-Cl-PAc, 3-OH-F8426-Cl-PAc	F8426, F8426-BAc, F8426-CAc	F8426, F8426-CAc, F8426-BAc

NATURE OF THE RESIDUE IN PLANTS IN SOYBEAN		PMRA #1151381
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-^{14}C]**
Test site	Greenhouse	
Treatment	Applied foliarly to soybean plants at the 4th trifoliate leaf stage	
Rate	17 or 70 g a.i./ha	17 or 70 g a.i./ha
End-use product	Dry flowable (50%)	
Preharvest interval	Samples of forage, hay and bean were collected 21, 51 and 84 days after treatment (DAT), respectively.	
For both labels, the majority of the total radioactive residues (TRRs) were in forage (0.052–0.056 ppm) and hay (0.045–0.067 ppm), compared to beans (0.001 ppm) at the low treatment rate. As TRRs in beans were very low, no further characterization or identification of residues was conducted. Approximately 90–93% of the TRRs in forage and hay were extractable with methanol:water. Enzyme hydrolysis of the postextraction solids resulted in the release of 1.5–1.9% of the TRRs (both radiolabels) in hay.		

Metabolites Identified	Major Metabolites (> 10% TRRs)		Minor Metabolites (< 10% TRRs)	
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-^{14}C]**
Soybean, forage	F8426, 3-OH-F8426-Cl-PAc, F8426-Cl-PAc	F8426, 3-OH-F8426-Cl-PAc, F8426-Cl-PAc	3-DM-F8426-Cl-PAc, F8426-BAc, F8426-CAc	3-DM-F8426-Cl-PAc, F8426-BAc, F8426-CAc
Soybean, hay	3-OH-F8426-Cl-PAc, F8426-Cl-PAc	3-OH-F8426-Cl-PAc, F8426-Cl-PAc	F8426, 3-DM-F8426-Cl-PAc, F8426-BAc, F8426-CAc	F8426, 3-DM-F8426-Cl-PAc, F8426-BAc, F8426-CAc

NATURE OF THE RESIDUE IN PLANTS IN WHEAT		**PMRA #1151391, 1151392**
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-^{14}C]**
Test site	Greenhouse	
Treatment	Applied foliarly to wheat plants between the middle and the end of the tillering stage.	
Rate	35 or 140 g a.i./ha	35 or 140 g a.i./ha
End-use product	Emulsifiable concentrate (EC)	
Preharvest interval	Samples of wheat forage were collected 19 DAT and wheat grain and straw were collected 63 DAT.	

For both labels, the majority of the total radioactive residues (TRRs) were in forage (0.122-0.137 ppm) and straw (0.243–0.257 ppm), compared to grain (0.001–0.002 ppm) at the low treatment rate. As TRRs were low in wheat grain, no further characterization or identification of residues was conducted.

Approximately 84–88% of the TRRs in forage and straw were extractable with methanol:water. Sequential treatment of the PES (hay and straw) with enzymes and decomplexing agents indicated that the majority of the radioactivity was associated with cellulose and starch.

Metabolites Identified	Major Metabolites (> 10% TRRs)		Minor Metabolites (< 10% TRRs)	
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-^{14}C]**
Wheat, forage	3-OH-F8426-Cl-PAc, 3-DM-F8426-Cl-PAc, F8426-∝-Conj-PAc	3-OH-F8426-Cl-PAc, 3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, F8426-CAc	F8426, F8426-Cl-PAc, F8426-CAc, F8426-∝-Conj-PAc
Wheat, straw	3-OH-F8426-Cl-PAc, 3-DM-F8426-Cl-PAc	3-OH-F8426-Cl-PAc, 3-DM-F8426-Cl-PAc	F8426, F8426-Cl-PAc, F8426-CAc, F8426-∝-Conj-PAc, F8426-∝-sulfo-PAc	F8426, F8426-Cl-PAc, F8426-CAc, F8426-∝-Conj-PAc, F8426-∝-sulfo-PAc

Overview of the Plant Metabolism Studies
Carfentrazone-ethyl was labelled in the phenyl ring or the carbonyl group of the triazole ring in all of the studies. Carfentrazone-ethyl is metabolized by hydrolysis of the ester bond with subsequent oxidation of the alkyl methyl moiety yielding F8426-Cl-PAc and 3-OH-F8426-Cl-PAc, respectively. Metabolite 3-OH-F8426-Cl-PAc is oxidized to a 3-carboxy intermediate which in turn is decarboxylated to form 3-DM-F8426-Cl-PAc. Dehydrohalogenation of the side chain of F8426-Cl-PAc and subsequent oxidation at the alkenyl moiety produced F8426-CAc and F8426-BAc, respectively. In cereal crops, metabolite F8426-Cl-PAc is converted to products such as F8426-∝-sulfo-PAc via substitution of the ∝-chloro group on F8426-Cl-PAc with cellular components such as glutathione and subsequent degradation of these conjugates.

CONFINED ROTATIONAL CROP STUDY USING RADISH, MUSTARD, WHEAT, SORGHUM		**PMRA #1150775, 1282646**			
Radiolabel Position		**[Phenyl-U-^{14}C]**		**[Triazole-^{14}C]**	
Test site		Greenhouse			
Formulation used for trial		Emulsifiable concentrate (EC)			
Application rate and timing		Carfentrazone-ethyl was applied to sandy loam soil in stock tanks at a rate of 35 g a.i./ha. Lettuce, radish and wheat were planted to the tanks 32, 92, 186 and 277 days after treatment (DAT).			
Metabolites Identified		**Major Metabolites (> 10% TRRs)**		**Minor Metabolites (< 10% TRRs)**	
Radiolabel Position	**Plantback Interval (days)**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Lettuce, leaf	186	F8426, 3-OH-F8426-BAc, F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	—	DM-F8426-BAc, 3-DM-F8426-Cl-PAc,	—
Radish, roots	186	3-OH-F8426-BAc, Me-3-OH-F8426-BAc	—	F8426, F8426-BAc	—
Radish, tops	32	3-OH-F8426-BAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc	F8426, F8426-BAc, DM-F8426-PAc	F8426, F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc
Radish, tops	92	3-OH-F8426-BAc, F8426-BAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc	F8426, 3-DM-F8426-Cl-PAc, DM-F8426-PAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc, DM-F8426-PAc, Me-3-OH-F8426-BAc

Metabolites Identified		Major Metabolites (> 10% TRRs)		Minor Metabolites (< 10% TRRs)	
Radiolabel Position	**Plantback Interval (days)**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Radish, tops	186	3-OH-F8426-BAc, Me-3-OH-F8426-BAc	F8426, 3-OH-F8426-BAc, Me-3-OH-F8426-BAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc, DM-F8426-PAc	F8426-BAc, 3-DM-F8426-Cl-PAc, DM-F8426-PAc,
Wheat, forage	32	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	F8426, DM-F8426-BAc, F8426-BAc, 3-DM-F8426-Cl-PAc	F8426, DM-F8426-BAc, F8426-BAc, 3-DM-F8426-Cl-PAc
Wheat, forage	92	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, DM-F8426-PAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc, Me-3-OH-F8426-BAc
Wheat, forage	186	F8426, 3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	F8426-BAc, 3-DM-F8426-Cl-PAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc
Wheat, forage	277	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	F8426, DM-F8426-BAc, F8426-BAc, 3-DM-F8426-Cl-PAc	F8426, DM-F8426-BAc, 3-DM-F8426-Cl-PAc
Wheat, straw	32	3-OH-F8426-BAc, DM-F8426-BAc	3-OH-F8426-BAc, DM-F8426-BAc	F8426, 3-DM-F8426-Cl-PAc, DM-F8426-PAc, F8426-BAc, Me-3-OH-F8426-BAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc, DM-F8426-PAc, Me-3-OH-F8426-BAc
Wheat, straw	92	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, DM-F8426-PAc, DM-F8426-BAc	F8426, 3-DM-F8426-Cl-PAc, F8426-BAc, DM-F8426-BAc	F8426, F8426-BAc, 3-DM-F8426-Cl-PAc, Me-3-OH-F8426-BAc
Wheat, straw	186	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, DM-F8426-PAc, Me-3-OH-F8426-BAc	F8426, 3-DM-F8426-Cl-PAc, F8426-BAc, DM-F8426-BAc	F8426, DM-F8426-BAc, F8426-BAc, 3-DM-F8426-Cl-PAc

Metabolites Identified		Major Metabolites (> 10% TRRs)		Minor Metabolites (< 10% TRRs)	
Radiolabel Position	**Plantback Interval (days)**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Wheat, straw	277	F8426, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, Me-3-OH-F8426-BAc	3-OH-F8426-BAc, 3-DM-F8426-Cl-PAc, DM-F8426-PAc, F8426-BAc, DM-F8426-BAc	F8426, DM-F8426-BAc, F8426-BAc, 3-DM-F8426-Cl-PAc, DM-F8426-PAc

NATURE OF THE RESIDUE IN LAYING HEN — **PMRA # 1151403, 1282646**

Fifteen laying hens were dosed with either phenyl ^{14}C-labelled or the carbonyl group of the triazole ^{14}C-labelled carfentrazone-ethyl for 7 consecutive days at a dose level of 10 mg/kg feed/day. Hens were sacrificed 6 hours after administering the final dose. The major route of elimination of the ^{14}C-residues was not determined in this metabolism study because the total radioactive residues (TRRs) were not analysed in the excreta.

The TRRs in tissues and eggs ranged from <0.0005 ppm to 0.063 ppm with highest levels found in the liver for both labels. Only liver samples were subject to further characterization and identification since residues in fat, muscle and eggs were less than 0.010 ppm for both labels.

Metabolites Identified	Major Metabolites (> 10% TRRs)		Minor Metabolites (< 10% TRRs)	
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
poultry, liver	F8426-Cl-PAc	F8426-Cl-PAc	3-OH-F8426-Cl-PAc, F8426-PAc	3-OH-F8426-Cl-PAc, F842

NATURE OF THE RESIDUE IN LACTATING GOAT — **PMRA # 1151348, 1282646**

Two lactating goats were dosed for seven consecutive days at levels of 58 mg/kg feed/day. Goats were sacrificed within 24 hours after administering the final dose.

Approximately 89% of the administered dose was found in the excreta (feces, urine and cage wash). Minor fractions of the administered dose (AD) were found in milk (0.13% AD) and tissues (0.06% AD).

Metabolites Identified	Major Metabolites (> 10% TRRs)		Minor Metabolites (< 10% TRRs)	
Radiolabel Position	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**	**[Phenyl-U-^{14}C]**	**[Triazole-5-^{14}C]**
Muscle, loin	F8426-Cl-PAc	—	F8426 F8426-CAc, F8426-PAc	—
Fat	F8426	—	F8426-Cl-PAc	—
Liver	F8426-Cl-PAc	F8426-Cl-PAc, F8426-PAc	F8426-CAc, F8426-PAc	—
Kidney	F8426-Cl-PAc, F8426-PAc	F8426-Cl-PAc, F8426-PAc	F8426-CAc	—
Milk	F8426-Cl-PAc	F8426-Cl-PAc	F8426-CAc, F8426-PAc	F8426-PAc

Overview of Animal Metabolism Studies

Carfentrazone-ethyl was radiolabelled in the phenyl ring or the carbonyl group of the triazole ring for all studies. In livestock, carfentrazone-ethyl is hydrolyzed to produce F8426-Cl-PAc.

The metabolite undergoes dehalogenation and dehydrohalogenation to produce F8426-PAc and F8426-CAc, respectively. In poultry, F8426-Cl-PAc undergoes oxidation of the allylic 3-methyl group to yield 3-OH-F8426-Cl-PAc.

CROP FIELD TRIALS ON ROOT VEGETABLES | **PMRA # 1151374, 1184589**

Fifteen crop field trials were conducted throughout the United States with 4 residue trials on carrots in Zones 3 (1 trial), 5 (1 trial) and 10 (2 trials), 5 residue trials on radish in Zones 2 (1 trial), 3 (2 trials), 5 (1 trial) and 10 (1 trial) and 6 residue trials on sugar beets in Zones 5 (1 trial), 5A (2 trials), 7 (1 trial), 10 (1 trial) and 11 (1 trial) during the 2002–2003 growing seasons.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 72.5–212.8 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
CARROTS							
F8426	107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	107.5	1	8	<0.05	<0.05	<0.05	<0.05
RADISH							
F8426	72.5–212.8	1	10	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	72.5–212.8	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	72.5–212.8	1	10	<0.05	<0.05	<0.05	<0.05
SUGAR BEET, ROOTS							
F8426	72.5–107.5	1	12	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	72.5–107.5	1	12	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	72.5–107.5	1	12	<0.05	<0.05	<0.05	<0.05
SUGAR BEET, TOPS							
F8426	72.5–107.5	1	12	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	72.5–107.5	1	12	<0.05	0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	72.5–107.5	1	12	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON POTATOES					PMRA #1151366, 1184585		
Sixteen crop field trials were conducted throughout the United States with 1 residue trial in each of Zones 2, 3, 9, and 10, 2 residue trials in each of Zones 1, 5 and 5A and 6 trials in Zone 11, during the 2001 growing season. At each test location, potato tubers were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 202.7–286.7 g a.i./ha and harvested at a PHI of seven days. A non-ionic surfactant (0.25% v/v), a crop oil concentrate (1.0% v/v) or an organosilicone wetting agent (0.09% v/v) was added to the spray mixture for all applications.							
Commodity	**Total Rate (g a.i./ha)**	**Preharvest Interval (days)**	**Residue Levels (ppm)***				
			n	**Min.**	**Max.**	**HAFT**	**Median**
POTATOES							
F8426	202.7–286.7	7	32	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	202.7–286.7	7	32	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	202.7–286.7	7	32	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	202.7–286.7	7	32	<0.05	<0.05	<0.05	<0.05
CROP FIELD TRIALS ON BULB VEGETABLES					**PMRA #1151303, 1184590**		
Five crop field trials were conducted throughout the United States with 2 residue trials on green onions in Zones 6 (1 trial) and 10 (1 trial) and 3 residue trials on dry bulb onions in Zones 5 (1 trial), 10 (1 trial) and 11 (1 trial), during the 2002 growing season. At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 62.7–107.5 g a.i./ha and harvested at a PHI of 1 day. A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.							
GREEN ONIONS							
F8426	107.5	1	4	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	107.5	1	4	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	107.5	1	4	<0.05	<0.05	<0.05	<0.05
DRY BULB ONIONS							
F8426	62.7–107.5	1	6	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	62.7–107.5	1	6	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	62.7–107.5	1	6	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON LEAFY VEGETABLES	PMRA #1151334, 1184595

Fourteen crop field trials were conducted throughout the United States with 4 residue trials on celery in Zones 3 (1 trial), 5A (1 trial) and 10 (2 trials), 4 residue trials on head lettuce in Zones 1 (1 trial), 3 (1 trial) and 10 (2 trials), 4 residue trials on leaf lettuce in Zones 1 (1 trial), 3 (1 trial) and 10 (2 trials) and 2 residue trials on spinach in Zones 1 (1 trial) and 10 (1 trial), during the 2002 and 2003 growing season.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 62.7–107.5 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
CELERY							
F8426	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
HEAD LETTUCE							
F8426	107.5	1	16	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	107.5	1	16	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	107.5	1	16	<0.05	0.05	<0.05	<0.05
LEAF LETTUCE							
F8426	107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	107.5	1	8	<0.05	<0.05	<0.05	<0.05
SPINACH							
F8426	107.5	1	4	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	107.5	1	4	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	107.5	1	4	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON BRASSICA LEAFY VEGETABLES	PMRA #1151305, 1184592

Thirteen crop field trials were conducted throughout the United States with 4 residue trials on broccoli in Zones 6 (1 trial), 10 (2 trials) and 12 (1 trial), 4 residue trials on cabbage in Zones 1 (1 trial), 5 (1 trial) and 10 (2 trials) and 5 residue trials on mustard greens with 1 trial in each of Zones 2, 4, 5, 6 and 10, during the 2002 and 2003 growing seasons.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 63.8–107.5 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
BROCCOLI							
F8426	107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	107.5	1	8	<0.05	<0.05	<0.05	<0.05
CABBAGE							
F8426	63.8–107.5	1	16	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	63.8–107.5	1	16	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	63.8–107.5	1	16	<0.05	<0.05	<0.05	<0.05
MUSTARD GREEN							
F8426	65–107.5	1	10	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	65–107.5	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	65–107.5	1	10	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON LEGUME VEGETABLES	PMRA #1151339, 1151352, 1184593, 1187064

Twenty-four crop field trials were conducted throughout the United States with 11 residue trials on succulent beans in Zone 1 (1 trial), Zone 2 (3 trials), Zone 3 (1trial), Zone 5 (1trial), Zone 5A (3 trials), and Zone 10 (2 trials), 4 residue trials on succulent peas in Zone 5A (2 trials) and Zone 11 (2 trials), 5 residue trials on dry beans in Zone 5 (1 trial), Zone 5A (2 trials), Zone 9 (1 trial) and Zone 10 (1 trial), and 4 residue trials on dry peas in Zone 11, during the 2002 growing season.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 62.7–107.5 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
BEAN, SUCCULENT							
F8426	66.1–107.5	1	22	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	66.1–107.5	1	22	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	66.1–107.5	1	22	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-BAc	66.1–107.5	1	22	<0.05	<0.05	<0.05	<0.05
PEA, SUCCULENT							
F8426	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-BAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
BEAN, DRY							
F8426	73.9–107.5	1	10	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	73.9–107.5	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	73.9–107.5	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-BAc	73.9-107.5	1	10	<0.05	<0.05	<0.05	<0.05
PEA, DRY							
F8426	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-BAc	62.7–107.5	1	8	<0.05	<0.05	<0.05	<0.05
CROP FIELD TRIALS ON SOYBEAN					**PMRA #1151382, 1151383, 1151384, 1151336, 1282646, 1326469, 1326472, 1337495**		

Thirty-three crop field trials were conducted throughout the United States in Zone 2 (3 trials), Zone 4 (4 trials), Zone 5 (22 trials) and Zone 5A (4 trials), during the 1994, 1995, 2002 and 2004 growing seasons. Of these trials, 23 were conducted using a postemergent application and the other 10 were conducted to reflect the harvest aid use.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF or 50 DF) at a total seasonal rate of 25.8-128.8 g a.i./ha and harvested at a PHI of 2 to 3 days and 72 to 141 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for 16 of the 33 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
SOYBEAN, seed							
F8426	25.8	2–3	20	<0.05	<0.05	<0.05	<0.05
	128.8	3	2	<0.05	<0.05	<0.05	<0.05
	25.8-51.5	72–141	48	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	25.8	2–3	20	<0.05	<0.05	<0.05	<0.05
	128.8	3	2	<0.05	<0.05	<0.05	<0.05
	25.8-51.5	72–141	48	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	25.8	2–3	20	<0.05	<0.05	<0.05	<0.05
	128.8	3	2	<0.05	<0.05	<0.05	<0.05
	25.8-51.5	72–141	48	<0.05	<0.05	<0.05	<0.05
SOYBEAN, forage							
F8426	25.8	0	4	0.67	1.45	1.23	0.85
F8426-Cl-PAc	25.8	0	4	0.23	0.47	0.47	0.37
3-OH-F8426-Cl-PAc	25.8	0	4	0.1	0.23	0.23	0.17
CROP FIELD TRIALS ON FRUITING VEGETABLES							
CROP FIELD TRIALS ON PEPPERS (bell and non-bell)					**PMRA #1151409, 1184605**		
Six crop field trials were conducted throughout the United States in Zone 2 (1 trial), Zone 3 (1 trial), Zone 6 (1 trial) and Zone 10 (3 trials), during the 2001and 2002 growing seasons. At each test location, fruits were treated with carfentrazone-ethyl formulated as a dry flowable (40 DF) at a total seasonal rate of 106.4–110.9 g a.i./ha and harvested at a PHI of 1 day. A non-ionic surfactant (1.0% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.							
Commodity	**Total Rate (g a.i./ha)**	**Preharvest Interval (days)**	**Residue Levels (ppm)***				
			n	**Min.**	**Max.**	**HAFT**	**Median**
PEPPER							
F8426	106.4–110.9	1	12	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	106.4–110.9	1	12	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	106.4–110.9	1	12	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	106.4–110.9	1	12	<0.05	<0.05	<0.05	<0.05
CROP FIELD TRIALS ON TOMATO					**PMRA # 1151410, 1184606**		
Eleven crop field trials were conducted throughout the United States in Zone 1 (1 trial), Zone 2 (1 trial), Zone 3 (2 trials) and Zone 10 (7 trials), during the 2001 growing season. At each test location, fruits were treated with carfentrazone-ethyl formulated as a dry flowable (40 DF) at a total seasonal rate of 106.4–217.3 g a.i./ha and harvested at a PHI of 1 day. A non-ionic surfactant (1.0% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.							

TOMATO							
F8426	106.4–217.3	1	24	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	106.4–217.3	1	24	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	106.4–217.3	1	24	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	106.4–217.3	1	24	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON CUCURBIT VEGETABLES — **PMRA # 1151346, 1184595**

Thirteen crop field trials were conducted throughout the United States with 4 residue trials on cucumbers in Zones 2 (1 trial), 3 (1 trial) and 10 (1 trial), 4 residue trials on summer squash in Zones 2 (2 trials), Zone 5 (1 trial) and Zone 10 (1 trial) and 5 residue trials on muskmelon in Zones 6 (1 trial) and 10 (4 trials) during the 2002 and 2003 growing seasons.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 50.4–254.2 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
CUCUMBER							
F8426	65–254.2	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	65–254.2	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	65–254.2	1	8	<0.05	<0.05	<0.05	<0.05
MUSKMELON							
F8426	50.4–107.5	1	10	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	50.4–107.5	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	50.4–107.5	1	10	<0.05	<0.05	<0.05	<0.05
SUMMER SQUASH							
F8426	50.4–107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	50.4–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	50.4–107.5	1	8	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON POME FRUITS — **PMRA # 1151365, 1184581**

Eighteen crop field trials were conducted throughout the United States with 12 residue trials on apples in Zones 1 (3 trials), 2 (1 trial), 5A (2 trials), 9 (1 trial), 10 (1 trial) and 11 (4 trials) and 6 residue trials on pears in Zones 1 (1 trial), 10 (2 trials) and 11 (3 trials) during the 2000 growing season.

At each test location, crops were treated with carfentrazone-ethyl formulated as an emulsifiable concentrate (2 EC) or a dry flowable (40 DF) at a total seasonal rate of 138.9 g a.i./ha and harvested at a PHI of 3 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications in 12 of the 18 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
APPLES							
F8426	138.9	3	24	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	138.9	3	24	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	138.9	3	24	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	138.9	3	24	<0.05	<0.05	<0.05	<0.05
PEARS							
F8426	138.9	3	12	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
CROP FIELD TRIALS ON STONE FRUITS					**PMRA # 1151377, 1184578**		
Twenty one crop field trials were conducted throughout the United States with 6 residue trials on cherries (sweet and tart) in Zones 1 (1 trial), 5A (2 trials), 9 (1 trial), 10 (1 trial) and 11 (1 trial), 9 residue trials on peaches in Zones 1 (1 trial), 2 (3 trials), 5A (1 trial), 6 (1 trial) and 10 (3 trials), and 6 residue trials on plums in Zones 5A (1 trial), 10 (4 trials) and 12 (1 trial during the 2000 growing season). At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC) or a dry flowable (40 DF) at a total seasonal rate of 138.9 g a.i./ha and harvested at a PHI of 3 days. A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications in 14 of the 21 trials.							
CHERRY (sweet and tart)							
F8426	138.9	3	12	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
PEACH							
F8426	138.9	3	18	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	138.9	3	18	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	138.9	3	18	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	138.9	3	18	<0.05	<0.05	<0.05	<0.05
PLUM							
F8426	138.9	3	12	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	138.9	3	12	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON BERRIES	PMRA # 1151304, 1184596, 1265783

Eight crop field trials were conducted throughout the United States with 4 residue trials on blueberries in Zones 1 (1 trial), 2 (2 trials) and 5A (1 trial), 2 residue trials on blackberries in Zone 2 (1 trial) and Zone 12 (1 trial), and 2 residue trials on raspberries in Zone 5A (1 trial) and Zone 12 (1 trial) during the 1998, 2002 and 2003 growing seasons.

At each test location, blueberries were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 42.6–107.5 g a.i./ha and harvested at a PHI of 1 day. Blackberries and raspberries were treated with carfentrazone-ethyl formulated as 2 EC and 2 EW, respectively, at a total seasonal rate of 53.8 or 448 g a.i./ha and harvested at a PHI of 14 or 15 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications for 6 of the 8 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
BLUEBERRIES							
F8426	42.6–107.5	1	8	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	42.6–107.5	1	8	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	42.6–107.5	1	8	<0.05	<0.05	<0.05	<0.05
BLACKBERRIES							
F8426	448	14–15	4	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	448	14–15	4	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	448	14–15	4	<0.05	<0.05	<0.05	<0.05
RASPBERRIES							
F8426	53.8–448	14–15	4	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	53.8–448	14–15	4	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	53.8–448	14–15	4	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON CEREAL GRAINS	
CROP FIELD TRIALS ON CORN, FIELD	**PMRA #1151314, 1151320, 1151321, 1151336, 1184576, 1265789, 1282646, 1326468, 1326469, 1337494**

Fourty-eight crop field trials were conducted throughout the United States in Zone 1 (2 trials), Zone 2 (4 trials), Zone 5 (36 trials), Zone 5A (1 trial), Zone 6 (2 trials), Zone 8 (1 trial) and Zone 10 (2 trials) during the 1994, 1995, 1998 and 2002 growing seasons. Of these trials, 40 were conducted using a postemergent application and the other 8 were conducted to reflect the harvest aid use.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF or 50 DF) at a total seasonal rate of 34.7 g a.i./ha and harvested at PHIs ranging from 3 to 123 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for 18 of the 48 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
CORN, FIELD, grain							
F8426	34.7	3	16	<0.05	<0.05	<0.05	<0.05
	171.4	3	2	<0.05	<0.05	<0.05	<0.05
	34.7	64–123	80	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3	16	<0.05	<0.05	<0.05	<0.05
	171.4	3	2	<0.05	<0.05	<0.05	<0.05
	34.7	64–123	80	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3	16	<0.05	<0.05	<0.05	<0.05
	171.4	3	2	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	64–123	80	<0.05	<0.05	<0.05	<0.05
Commodity	**Total Rate (g a.i./ha)**	**Preharvest Interval (days)**	**Residue Levels (ppm)**				
			n	**Min.**	**Max.**	**HAFT**	**Median**
CORN, FIELD, forage							
F8426	34.7	3	16	<0.05	<0.05	<0.05	<0.05
	34.7	38–90	80	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3	16	<0.05	<0.05	<0.05	<0.05
	34.7	38–90	80	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3	16	<0.05	<0.05	<0.05	<0.05
	34.7	38-90	68	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	38–90	80	<0.05	0.1	0.1	<0.05

CORN, FIELD, stover							
F8426	34.7	3	16	<0.05	<0.10	<0.10	<0.10
	171.4	3	2	<0.10	<0.10	<0.10	<0.10
	34.7	64–123	80	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3	16	<0.05	0.41	0.384	0.261
	171.4	3	2	<0.10	<0.10	<0.10	<0.10
	34.7	64–123	80	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3	16	<0.05	<0.10	<0.10	<0.10
	171.4	3	2	<0.10	<0.10	<0.10	<0.10
	34.7	64–123	32	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	64–123	80	<0.05	0.11	0.1	<0.05

CROP FIELD TRIALS ON CORN, SWEET — **PMRA #1151325, 1151326, 1151336, 1187062, 1184576, 1326468, 1326469, 1337494**

Seventeen crop field trials were conducted throughout the United States in Zone 2 (5 trials), Zone 3 (2 trials), Zone 5 (3 trials), Zone 5A (3 trials), Zone 10 (1 trial) and Zone 12 (3 trials) during the 1995, 1996 and 2002 growing seasons. Of these trials, 13 were conducted using a postemergent application and the other 4 were conducted to reflect the harvest aid use.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF or 50 DF) at a total seasonal rate of 34.7 g a.i./ha and harvested at PHIs ranging from 3 to 107 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for 7 of the 17 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
CORN, SWEET, ears							
F8426	34.7	3	8	<0.05	<0.05	<0.05	<0.05
	34.7	27–85	26	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3	8	<0.05	<0.05	<0.05	<0.05
	34.7	27–85	26	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3	8	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	27–85	26	<0.05	<0.05	<0.05	<0.05
CORN, SWEET, forage							
F8426	34.7	27–70	26	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	27–70	26	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	27–70	26	<0.05	0.07	0.06	<0.05

CORN, SWEET, stover							
F8426	34.7	3	8	<0.05	0.101	0.099	0.075
	34.7	27–107	26	<0.05	0.05	0.05	<0.05
F8426-Cl-PAc	34.7	3	8	<0.05	0.254	0.247	0.086
	34.7	27–107	26	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3	8	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	27–107	26	<0.05	0.12	0.09	<0.05

CROP FIELD TRIALS ON SORGHUM	**PMRA # 1151378, 1151380, 1151336, 1187062, 1326468, 1326469, 1337494**

Fourteen crop field trials were conducted throughout the United States in Zone 4 (2 trials), Zone 5 (6 trials), Zone 6 (3 trials) and Zone 8 (3 trials) during the 1994, 1995 and 2002 growing seasons.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC) or a dry flowable (40 DF or 50 DF) at a total seasonal rate of 16.8 or 84 g a.i./ha and harvested at PHIs ranging from 3 to 117 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for 6 of the 14 trials.

Commodity	**Total Rate (g a.i./ha)**	**Preharvest Interval (days)**	**Residue Levels (ppm)**				
			n	**Min.**	**Max.**	**HAFT**	**Median**
SORGHUM, grain							
F8426	16.8	3–4	8	<0.05	0.101	0.097	0.086
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
	84	3	2	0.112	0.157	0.135	0.135
F8426-Cl-PAc	16.8	3–4	8	<0.05	0.131	0.118	0.053
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
	84	3	2	0.24	0.246	0.243	0.243
3-OH-F8426-Cl-PAc	16.8	3–4	8	<0.05	<0.05	<0.05	<0.05
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
	84	3	2	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	16.8	92–104	6	<0.05	<0.05	<0.05	<0.05

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
SORGHUM, forage							
F8426	16.8	3–4	4	<0.05	<0.05	<0.05	<0.05
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	16.8	3–4	4	<0.05	<0.05	<0.05	<0.05
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	16.8	3–4	4	<0.05	<0.05	<0.05	<0.05
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	16.8	61–75	6	<0.05	<0.05	<0.05	<0.05
SORGHUM, stover							
F8426	16.8	3–4	8	<0.05	<0.05	<0.05	<0.05
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	16.8	3–4	8	0.082	0.156	0.151	0.101
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	16.8	3–4	8	<0.05	<0.05	<0.05	<0.05
	16.8	90–117	20	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	16.8	92–104	6	<0.05	<0.05	<0.05	<0.05
CROP FIELD TRIALS ON WHEAT					**PMRA # 1151389, 1151390, 1151393, 1151336, 1265789, 1282646, 1326468, 1326469, 1337494.**		

Thirty-two crop field trials were conducted throughout the United States in Zone 2 (1 trial), Zone 4 (1 trial), Zone 5 (8 trials), Zone 6 (1 trial), Zone 7 (8 trials), Zone 8 (9 trials), Zone 10 (2 trials) and Zone 11 (2 trials) during the 1994, 1995, 2002 and 2004 growing seasons. Of these trials, 24 were conducted using a postemergent application and the other 8 were conducted to reflect the harvest aid use.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water-based concentrate (2 EW) or a dry flowable (40 or 50 DF) at a total seasonal rate of 34.7 g a.i./ha and harvested at a PHIs of 3 to 104 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for 11 of the 32 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)				
			n	Min.	Max.	HAFT	Median
WHEAT, grain							
F8426	34.7	3–4	16	<0.05	<0.05	<0.05	<0.05
	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3–4	16	<0.05	<0.05	<0.05	<0.05
	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3–4	16	<0.05	<0.05	<0.05	<0.05
	34.7	46–104	22	<0.05	<0.05	<0.05	<0.05
Commodity	**Total Rate (g a.i./ha)**	**Preharvest Interval (days)**	**Residue Levels (ppm)**				
			n	**Min.**	**Max.**	**HAFT**	**Median**
3-DM-F8426-Cl-PAc	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05
WHEAT, forage							
F8426	34.7	3	4	0.087	0.163	0.152	0.119
	34.7	7–8	44	<0.05	0.43	0.42	<0.05
	34.7	28–33	4	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3	4	<0.05	0.11	0.1	0.070
	34.7	7–8	44	<0.05	0.14	0.12	<0.05
	34.7	28–33	4	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3	4	0.238	0.428	0.391	0.318
	34.7	7–8	44	<0.05	0.48	0.45	0.065
	34.7	28–33	4	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	7–8	44	<0.05	0.1	0.08	<0.05
	34.7	28–33	4	<0.05	<0.05	<0.05	<0.05
WHEAT, straw							
F8426	34.7	3–4	16	<0.10	0.461	0.414	0.121
	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	3–4	16	<0.10	1.54	1.43	0.715
	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	3–4	16	<0.05	0.122	0.086	<0.10
	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	34.7	46–104	48	<0.05	<0.05	<0.05	<0.05

WHEAT, hay							
F8426	34.7	15–70	44	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	34.7	15–70	44	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	34.7	15–70	44	<0.05	0.18	0.15	<0.05
3-DM-F8426-Cl-PAc	34.7	15–70	44	<0.05	0.06	0.06	<0.05

CROP FIELD TRIALS ON OILSEEDS

CROP FIELD TRIALS ON CANOLA — **PMRA # 1151310, 1151311, 1184597, 1187049**

Five crop field trials were conducted throughout the United States in Zone 5 (1 trial), Zone 7 (2 trials), Zone 11 (2 trials) during the 2002-2003 growing seasons.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 62.7–360 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
CANOLA							
F8426	62.7–360	1	10	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	62.7–360	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	62.7–360	1	10	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON SUNFLOWER — **PMRA # 1151386, 1184598**

Four crop field trials were conducted throughout the United States in Zone 5A (2 trials) and Zone 7 (2 trials) during the 2002 growing season.

At each test location, crops were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 73.9–280 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
SUNFLOWER, seeds							
F8426	73.9–280	1	10	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	73.9–280	1	10	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	73.9–280	1	10	<0.05	<0.05	<0.05	<0.05

OTHER CROPS

CROP FIELD TRIALS ON GRAPES — **PMRA # 1151349, 1184584**

Twelve crop field trials were conducted throughout the United States in Zone 1 (2 trials), Zone 10 (2 trials) and Zone 11 (8 trials) during the 2000 growing season.

At each test location, grapes were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC) or a dry flowable (40 DF) at a total seasonal rate of 138.9 g a.i./ha and harvested at a PHI of 3 days.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications in 7 of the 12 trials.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
GRAPES							
F8426	138.9	3	24	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	138.9	3	24	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	138.9	3	24	<0.05	<0.05	<0.05	<0.05
3-DM-F8426-Cl-PAc	138.9	3	24	<0.05	<0.05	<0.05	<0.05

CROP FIELD TRIALS ON STRAWBERRIES — **PMRA # 1151385, 1184599**

Eight crop field trials were conducted throughout the United States in Zone 1 (1 trial), Zone 2 (1 trial), Zone 3 (2 trials), Zone 5A (1 trial), Zone 10 (2 trials) and Zone 12 (1 trials) during the 2002 and 2003 growing seasons.

At each test location, fruits were treated with carfentrazone-ethyl formulated as either an emulsifiable concentrate (2 EC), an emulsifiable water based concentrate (2 EW) or a dry flowable (40 DF) at a total seasonal rate of 53.8–107.5 g a.i./ha and harvested at a PHI of 1 day.

A non-ionic surfactant (0.25% v/v) or a crop oil concentrate (1.0% v/v) was added to the spray mixture for all applications.

Commodity	Total Rate (g a.i./ha)	Preharvest Interval (days)	Residue Levels (ppm)*				
			n	Min.	Max.	HAFT	Median
STRAWBERRIES							
F8426	53.8–107.5	1	16	<0.05	<0.05	<0.05	<0.05
F8426-Cl-PAc	53.8–107.5	1	16	<0.05	<0.05	<0.05	<0.05
3-OH-F8426-Cl-PAc	53.8–107.5	1	16	<0.05	<0.05	<0.05	<0.05

* In these crop field trial studies, the majority of the residue levels of the parent and metabolites were reported as less than LOD for all crops. The method LOQ was established at 0.05 ppm.

PROCESSED FOOD AND FEED	PMRA #1151317, 1151323, 1151349, 1151350 1151365, 1151366, 1151377, 1151379, 1151383, 1151410, 1337494

Processing studies were conducted on apple, field corn, grape, plum, potato, sorghum, soybean, tomato and wheat. Results from these studies indicated that there were no detectable residues of carfentrazone-ethyl and the metabolites F8426-Cl-PAc and 3-OH-F8426-Cl-PAc in any processed commodities except for sorghum where residues concentrated in aspirated grain fractions.

Processing studies were not conducted on canola, sugar beets and sunflower because there were no detectable residues in the RAC when crops were treated at more than 5× the recommended label rate.

STORAGE STABILITY	PMRA #1151308, 1151343, 1151344, 1151395, 1151396

Storage stability studies were conducted on orange and its processed commodities (dried pulp, juice and oil), wheat grain, wheat greenplant, barley straw, soybean seed, sweet corn, field corn starch and field corn oil.

Results from these studies indicated that carfentrazone-ethyl was stable for 6 months in field corn starch, 10 months in sweet corn, 12 months in orange and its processed commodities (dried pulp, juice and oil), 22 months in soybean seed and field corn oil, and 24 months in wheat grain, wheat green plant and barley straw.

Residues of metabolites F8426-Cl-PAc, 3-OH-F8426-Cl-PAc and 3-DM-F8426-Cl-PAc were stable for 12 months in orange and its processed commodities (dried pulp, juice and oil), 22 months in soybean seed, sweet corn ears, field corn starch and field corn oil, and 24 months in wheat grain, wheat green plant and barley straw.

LIVESTOCK FEEDING	PMRA #1151331, 1282646, 1265787

Dairy cows were orally dosed with carfentrazone-ethyl at dosing levels of 1, 3 and 10 ppm daily for 28 consecutive days.

All animals were sacrificed within 24 hours of administering the final dose except for 2 animals from the highest dose group which were sacrificed 3 and 6 days after the final dose, during the recovery period.

Since there were no detectable residues in tissue and milk samples from cows fed at the 3 ppm level, cow samples from the 1 ppm level were not analysed.

Matrix	Feeding Level (ppm)	Residue Levels (ppm)		
		F8426	F8426-Cl-PAc	F8426-PAc
Milk	3	<0.005	<0.005	<0.005
	10	<0.005	<0.005–0.008	<0.005
Cream	3	<0.01	<0.01	<0.01
	10	<0.01	<0.01	<0.01
Milk, skim	3	Not analysed	<0.005	<0.005
	10	Not analysed	<0.005–0.005	<0.005
Fat	3	<0.01	<0.01	<0.01
	10	<0.01	<0.01	<0.01
Kidney	3	Not analysed	<0.01	<0.01
	10	Not analysed	<0.01–0.013	<0.01
Liver	3	Not analysed	<0.01	<0.01

Matrix	Feeding Level (ppm)	Residue Levels (ppm)		
		F8426	F8426-Cl-PAc	F8426-PAc
	10	Not analysed	<0.01	<0.01
Muscle	3	Not analysed	<0.01	<0.01
	10	Not analysed	<0.01	<0.01

Table 6 Food Residue Chemistry Overview of Metabolism Studies and Risk Assessment

PLANT STUDIES	
RESIDUE DEFINITION FOR ENFORCEMENT **Primary crops** **Rotational crops**	Carfentrazone-ethyl and metabolite F8426-Cl-PAc
RESIDUE DEFINITION FOR RISK ASSESSMENT **Primary crops** **Rotational crops**	Carfentrazone-ethyl and metabolites F8426-Cl-PAc, 3-OH-F8426-Cl-PAc, 3-OH-F8426-BAc, F8426-BAc and Me-3-OH-F8426-BAc
METABOLIC PROFILE IN DIVERSE CROPS	The metabolic profile of carfentrazone-ethyl is understood in a variety of crops.
ANIMAL STUDIES	
ANIMALS	**Ruminant**
RESIDUE DEFINITION FOR ENFORCEMENT	Carfentrazone-ethyl and metabolite F8426-Cl-PAc
RESIDUE DEFINITION FOR RISK ASSESSMENT	Carfentrazone-ethyl and metabolite F8426-Cl-PAc
METABOLIC PROFILE IN ANIMALS **(goat, hen, rat)**	Similar in hen, ruminant and rat.
FAT SOLUBLE RESIDUE	Yes

DIETARY RISK FROM FOOD AND WATER			
	POPULATION	ESTIMATED RISK % of ACCEPTABLE DAILY INTAKE (ADI)	
		Food Only	Food and Water
Refined chronic non-cancer dietary risk **ADI = 0.09 mg/kg bw/d** **Estimated chronic drinking water concentration = 20.5 µg a.i./L**	**All infants < 1 year**	20.6	22.2
	Children 1 to 2 years	47.7	48.4
	Children 3 to 5 years	43.3	44
	Children 6 to 12 years	28.7	29.1
	Youth 13 to 19 years	17.1	17.5
	Adults 20 to 49 years	14.4	14.8
	Adults 50+ years	11.8	12.3
	Total population	18	18.4

Table 7 Environmental Fate of Carfentrazone-ethyl and its Transformation Products

Study Type	Test Material	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Abiotic transformation						
Hydrolysis	Carfentrazone-ethyl	30 d	20°C 25°C pH 5 stable stable pH 7 13.7 d 8.6 d pH 9 0.21 d 0.15 d	Major route of transformation under neutral & basic conditions	Carfentrazone-chloropropionic acid (stable to further hydrolysis)	PMRA 1155114 PMRA 1310349
Phototrans-formation—soil	Carfentrazone-ethyl	Loamy sand (pH 5.4, sand 80%, silt 14%, clay 6%, OM 3.4%)	stable (70% of parent was present after 30 d of exposure at 25°C)	Not a major route of transformation	Not reported	PMRA 1150781
Phototrans-formation—water	Carfentrazone-ethyl	25°C, pH 5	DT_{50} 8.3 d	Major route of transformation	Carfentrazone-chloropropionic acid	PMRA 1150779 PMRA 1150780
	Carfentrazone-chloropropionic acid	25°C, pH 5-9	DT_{50} 5.4-6.0 d		Not reported	PMRA 1150782
Phototrans-formation—air	Carfentrazone-ethyl	Photochemical oxidative degradation	4.6 h	Major route of transformation	Not reported	PMRA 1310349

Study Type	Test Material	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Biotransformation						
Soil—aerobic	Carfentrazone-ethyl	20°C; four soils: pH 4.5–5.8; % OC 2–3.4	DT_{50} 0.1-1.3 d	Non persistent	Carfentrazone -chloropropionic acid -propionic acid -cinamic acid -benzoic acid	PMRA 1155116
	Carfentrazone-chloropropionic acid		DT_{50} 11.3-85.6 d	Non to moderately persistent	Not reported	PMRA 1155117
Soil—anaerobic	Carfentrazone-ethyl	20°C; loamy sand (Speyer 2.2); pH 5.8 % OC 3.1	DT_{50} 0.8 d	Non persistent	Carfentrazone -chloropropionic acid -propionic acid	PMRA 1155281
Water/sediment—aerobic	Carfentrazone-ethyl	20°C; two systems, pH 7.85–8.0 (water)	DT_{50}<1.2 d	Non persistent. No significant accumulation in the sediment.	Carfentrazone -chloropropionic acid -propionic acid -cinamic acid -benzoic acid	PMRA 1150765 PMRA 1310348 PMRA 1310349
Mobility						
Adsorption/desorption	Carfentrazone-ethyl	Five soils (pH 4.8–6.4, 0.2–3.4% OC)	Not determined due to instability under the test conditions			PMRA 1310349 PMRA 1150762 PMRA 1150764
	Carfentrazone-chloropropionic acid		K_{oc} 7.4-46.4	High mobility		
	Carfentrazone-propionic acid		K_{oc} 51–260	High to moderate mobility		
	Carfentrazone-cinamic acid		K_{oc} 44–333	Very high to moderate mobility		
	Carfentrazone-benzoic acid		K_{OC} 4–41	Very high mobility		
Soil column leaching	Carfentrazone-ethyl	Five soils (pH 4.8–6.4, 0.2–3.4% OC) aged for 10 d	Not detected in leachate	Not mobile		PMRA 1150778 PMRA 1155282
	Carfentrazone-chloropropionic acid		0–66.2% in leachate	Mobile in soils tested		
	Carfentrazone-cinamic acid		0.2–14.9 % in leachate			
	Carfentrazone-benzoic acid		5.1–22.2 % in leachate			
Field Studies						

Study Type	Test Material	Study Conditions	Value or Endpoint	Interpretation	Major Transformation Products	Reference
Field dissipation	Carfentrazone-ethyl	One site relevant to Canadian conditions (Polk County, Minnesota)	DT_{50} 5 d No radioactivity found below 20 cm depth. The registrant-calculated half-life for the dissipation of the total residues was 32 d based on the first part of the biphasic degradation (0–61 DAT) and 108 d based on a linear degradation.		Carfentrazone -chloropropionic acid -propionic acid -cinamic acid -benzoic acid	PMRA 1155283 PMRA 1150783

Table 8 Environmental Toxicity of Carfentrazone-ethyl and its Transformation Products

Organism	Study Type	Species	Test Material	Endpoint	Value (effect)	Effect of Concern	Reference
Terrestrial Species							
Invertebrates	Acute oral	Honey bee (*Apis mellifera*)	Carfentrazone-ethyl 50 WG	24-h LD_{50}	200 µg ai/bee	Mortality	PMRA 1151787
	Acute contact	Earthworm (*Eisenia foetida*)	Carfentrazone-ethyl	14-d LC_{50}	>820 mg a.i./kg soil	Mortality	PMRA 1310349
			Carfentrazone-chloropropionic acid		>1000 mg a.i./kg soil		PMRA 1153989
			Carfentrazone-propionic acid				PMRA 1153995
			Carfentrazone-cinamic acid				PMRA 1154004
			Carfentrazone-benzoic acid				PMRA 1153985
		Honey bee (*Apis mellifera*)	Carfentrazone-ethyl	24-h LD_{50} 48-h LD_{50}	200 µg ai/bee >27.9 µg a.i./bee	Mortality	PMRA 1151787 PMRA 1151769
		Predatory mite (*Typhlodromus pyri*)	Carfentrazone-ethyl 50 WG 20–25 g a.i./ha	14-d beneficial capacity	0% 0%	Mortality fecundity	PMRA 1310349
		Parasitic wasp (*Aphidius rhopalosiphi*)			0% 3%	Mortality fecundity	
		Carabid beetle (*Poecilus cupreus*)			0% 0%	Mortality consumption	

Organism	Study Type	Species	Test Material	Endpoint	Value (effect)	Effect of Concern	Reference
		Staphylinid beetle (*Aleochara bilineata*)			0% 17%	Mortality parasitism	
Birds	Acute oral	Bobwhite quail (*Colinus virginianus*)	Carfentrazone-ethyl	LD_{50}	>2250 mg ai/kg bw	Mortality	PMRA 1953193
	Dietary	Bobwhite quail (*Colinus virginianus*)		LC_{50}	>5620 mg ai/kg diet	Mortality	PMRA 1153981
	Dietary	Mallard duck (*Anas platyrhynchos*)		LC_{50}	>5620 mg ai/kg diet	Mortality	PMRA 1153982
	Chronic	Bobwhite quail (*Colinus virginianus*)		NOEC	1000 mg ai/kg diet	Reproduction	PMRA 1154885
		Mallard duck (*Anas platyrhynchos*)		NOEC	1000 mg ai/kg diet	Reproduction	PMRA 1154884
Mammals	Acute oral	Rat	Carfentrazone-ethyl	LD_{50}	5000 mg ai/kg bw	Mortality	PMRA 1154880
	Dietary	Rat	Carfentrazone-ethyl	90 d NOEC	4000 mg ai/kg diet	Growth	PMRA 1265815
	Chronic (2-generation)	Rat	Carfentrazone ethyl	NOEC	1500 mg ai/kg diet	Reproduction	PMRA 1265829
Plants	Seed germination	10 plant species	Carfentrazone ethyl (rate 70 g a.i./ha)	EC_{25}	≥42.5 g a.i./ha	Radicle length	PMRA 1153203 PMRA 1153204
	Seedling emergence			EC_{25}	≥19 g a.i./ha	Length = weight	
	Vegetative vigour			EC_{25}	≥1.0 g a.i./ha	Weight	
Freshwater Organisms							
Invertebrates	Acute	*Daphnia magna*	Carfentrazone-ethyl	48-h EC_{50}	> 9.8 mg a.i./L	Immobility	PMRA 1265727 PMRA 1310349

Organism	Study Type	Species	Test Material	Endpoint	Value (effect)	Effect of Concern	Reference
			carfentrazone-chloropropionic acid		> 101 mg a.i./L		PMRA 1265748
			carfentrazone-propionic acid		> 102 mg a.i./L		PMRA 1265744
			carfentrazone-cinamic acid		> 10.7 mg a.i./L		PMRA 1265750
			carfentrazone-benzoic acid		> 92.8 mg a.i./L		PMRA 1265741
	Chronic		Carfentrazone-ethyl	21-d NOEC	0.22 mg a.i./L		PMRA 1310349
Fish	Acute	Rainbow trout (*Oncorhynchus mykiss*)	Carfentrazone-ethyl	96-h LC_{50}	1.6 mg a.i./L	Mortality	PMRA 1265725
			Carfentrazone-chloropropionic acid		> 99.2 mg a.i./L		PMRA 1265747
			Carfentrazone-propionic acid		> 95.6 mg a.i./L		PMRA 1265745
			Carfentrazone-cinamic acid		> 25.4 mg a.i./L		PMRA 1265751
			Carfentrazone-benzoic acid		> 92.5 mg a.i./L		PMRA 1265742
		Bluegill sunfish (*Lepomis macrochirus*)	Carfentrazone-ethyl	96-h LC_{50}	2.0 mg a.i./L		PMRA 1265726
	Chronic (Early Life Stage)	Rainbow trout (*Oncorhynchus mykiss*)	Carfentrazone-ethyl	NOEC	0.118 mg a.i./L 0.016 mg a.i./L		PMRA 1154888 PMRA 1155112*
Algae	Acute	Green alga (*Selenastrum capricornutum*)	Carfentrazone-ethyl	EC_{50}	16.2 µg a.i./L 13.3 µg a.i./L	Growth and reproduction	PMRA 1265731 PMRA 1153991
			carfentrazone-chloropropionic acid		534 µg a.i./L		PMRA 1265746
			carfentrazone-propionic acid		139 µg a.i./L		PMRA 1265743
			carfentrazone-cinamic acid		112 µg a.i./L 26.2 µg a.i./L		PMRA 1154893 PMRA 1265749

Organism	Study Type	Species	Test Material	Endpoint	Value (effect)	Effect of Concern	Reference
			carfentrazone-benzoic acid		12.6 µg a.i./L		PMRA 1265740
		Blue-green algae (*Anabaena flos-aquae*)	Carfentrazone-ethyl	EC_{50}	17.2 µg a.i./L 12.0 µg a.i./L		PMRA 1265735 PMRA 1310349
		Diatom (*Navicula pelliculosa*)		EC_{50}	6.5 µg a.i./L		PMRA 1265734
Vascular Plants	Acute	Duck weed (*Lemna gibba*)	Carfentrazone-ethyl	14-d EC_{50} NOEC	5.9 µg a.i./L 2.2 µg a.i./L		PMRA 1265732 & PMRA 1310349
Marine/Estuarine Organisms							
Invertebrates	Acute	Mysid shrimp (*Mysidopsis bahia*)	Carfentrazone-ethyl	LC_{50} NOEC	1.16 mg a.i./L 0.4 mg a.i./L		PMRA 1265737
		Eastern oyster *(Crassostrea virginica)*		LC_{50} NOEC	2.05 mg a.i./L 0.6 mg a.i./L	Shell deposition	PMRA 1265738
Fish	Acute	Tidewater silverside *(Menidia beryllina)*		LC_{50} NOEC	1.14 mg a.i./L 0.44 mg a.i./L	Mortality	PMRA 1265739
Algae	Acute	*Skeletonema costatum*		EC_{50} NOEC	16 µg a.i./L 10 µg a.i./L		PMRA 1265733

* Study conducted under solar violet radiation exposure (carfentrazone is phototoxic, i.e. exhibits photoinduced toxicity).

Table 9 Summary of Screening Level Risk Assessment of Carfentrazone-ethyl to Terrestrial Organisms

Organism	Exposure	Endpoint Reported	Use Rate (g a.i./ha)	EEC	RQ
Invertebrates					
Earthworm	Acute	LD_{50} = 820 mg a.i./kg soil	84	0.037 mg a.i./kg soil	4.5×10^{-5}
Honeybee	Acute contact	LD_{50} = 27.9 µg a.i./bee (31.25 kg a.i./ha)		0.084 kg a.i./ha	2.7×10^{-3}

Birds					
Bobwhite quail	Dietary	LC_{50} = 5620 mg ai/kg diet	84	14.71 mg ai/kg diet	2.6×10^{-3}
	Reproduction	NOEC = 1000 mg a.i./kg diet			1.5×10^{-2}
Mallard	Dietary	LC_{50} = 5620 mg a.i./kg diet		2.84 mg a.i./kg diet	5.0×10^{-4}
	Reproduction	NOEC = 1000 mg a.i./kg diet			2.8×10^{-3}
Mammals					
Rat	Dietary	NOEC = 4000 mg a.i./kg diet	84	42.38 mg a.i./kg diet	1.1×10^{-2}
	Reproduction	NOEC = 1500 mg a.i./kg diet			2.8×10^{-2}
Plants					
Plants	Seedling emergence (onion)	EC_{25} = 10 g a.i./ha	8.76	8.76 g a.i./ha	0.87
			84	84 g a.i./ha	8.4
	Vegetative vigour (cabbage)	EC_{25} = 1 g a.i./ha	8.76	8.76 g a.i./ha	8.76
			84	84 g a.i./ha	84

Table 10 Refined Risk Assessment of Carfentrazone-ethyl to Terrestrial Plants

Organism	Exposure	EC_{25}	Use Rate (g a.i./ha)	Drift EEC*	RQ
Plants	Seedling emergence (onion)	10 g a.i./ha	8.76	0.525 g a.i./ha	0.05
			84	5.04 g a.i./ha	0.2
	Vegetative vigour (cabbage)	1 g a.i./ha	8.76	0.52 g a.i./ha	0.5
			84	5.04 g a.i./ha	5

* Based on drift of 6% for a default droplet size of medium (herbicides).

Table 11 Summary of Screening Level Risk Assessment of Carfentrazone-ethyl to Aquatic Organisms

Organism	Exposure	Species	Endpoint Reported (mg a.i./L)	Endpoint for RA* (mg a.i./L)	Use Rate (g a.i./ha)	EEC** (mg a.i./L)	RQ
Freshwater Species							
Invertebrates	Acute	*D. magna*	LC_{50} = 9.8	4.9	84	0.0105	2.1×10^{-3}
	Chronic	*D. magna*	NOEC = 0.22	0.22			4.8×10^{-2}
Fish	Acute	Rainbow trout	LC_{50} = 1.6	0.8	84	0.0105	1.3×10^{-2}
	Chronic	Rainbow trout (Early Life Cycle)	NOEC = 0.016	0.016			6.5×10^{-1}
Plants	Acute	Diatom	EC_{50} = 0.0065	0.0033	8.76	0.001	3.4×10^{-1}
					84	0.0105	3.23
	Acute	Duckweed	EC_{50} = 0.0059	0.003	8.76	0.001	3.7×10^{-1}
					84	0.0105	3.56
Amphibian	Acute	Rainbow trout (surrogate)	LC_{50} = 1.6	0.8	84	0.056	7.0×10^{-2}
	Chronic	Fish Early Life Cycle (surrogate)	NOEC = 0.016	0.016	8.76	0.006	3.6×10^{-1}
					84	0.056	3.5
Estuarine and Marine Species							
Invertebrates	Acute	Mysid shrimp	LC_{50} = 1.16	0.58	84	0.0105	1.8×10^{-2}
Fish	Acute	Tidewater silverside	LC_{50} = 1.1	0.11			9.5×10^{-2}
Plants	Acute	Algae	EC_{50} = 0.016	0.008	8.76	0.001	1.3×10^{-1}
					84	0.0105	1.3

* Endpoints used in the acute exposure risk assessment (RA) are derived by dividing the EC_{50} or LC_{50} from the appropriate laboratory study by a factor of two (2) for aquatic invertebrates and plants, and by a factor of ten (10) for fish and amphibians.

** EEC based on a 15 cm water body depth for amphibians and a 80 cm water depth for all other aquatic organisms.

Table 12 Refined Risk Assessment of Carfentrazone-ethyl to Aquatic Organisms from Spray Drift

Organism	Exposure	Toxicity Endpoint (mg a.i./L)	Use Rate (g a.i./ha)	Drift EEC* (mg a.i./L)	RQ
Amphibians	Chronic	0.016	84	0.0034	2.0×10^{-1}
Fish	Chronic	0.016	84	0.0006	3.7×10^{-2}
Freshwater algae	Acute	0.00375	84	0.0006	1.6×10^{-1}
Vascular plants	Acute	0.00295	84	0.0006	2.0×10^{-1}
Marine algae	Acute	0.008	84	0.0006	7.5×10^{-2}

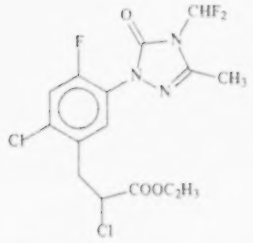
* Based on drift of 6% for a default droplet size of medium (herbicides).

Table 13 Risk Assessment of Carfentrazone-ethyl for Freshwater Organisms from Predicted Run-off

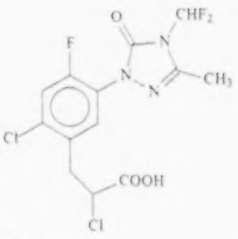
Toxicity Endpoint	EEC (µg a.i./L)*	Endpoint (µg a.i./L)	RQ
Amphibians			
Chronic	6.69	16	4.2×10^{-1}
Fish			
Chronic	6.69	16	4.2×10^{-1}
Freshwater Algae			
Acute	6.97	3.25	2.14
Marine/Estuarine Algae			
Acute	6.97	8	8.7×10^{-1}
Freshwater Vascular Plants			
Acute	6.97	2.95	2.36

* 90th percentile of peak and 21d runoff values for acute for chronic, respectively.

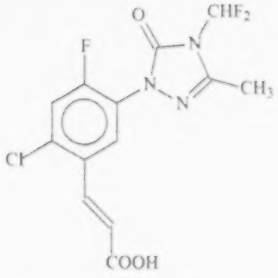
Figure 2 Major Transformation Products and Proposed Transformation Pathway of Carfentrazone



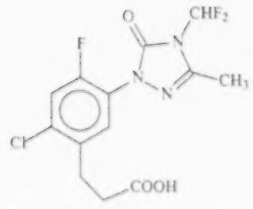
Carfentrazone
(F8426)



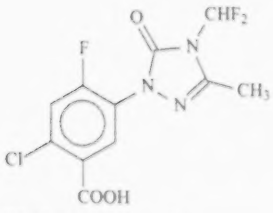
F8426-chloropropionic acid
(F8426-C1-PAc)



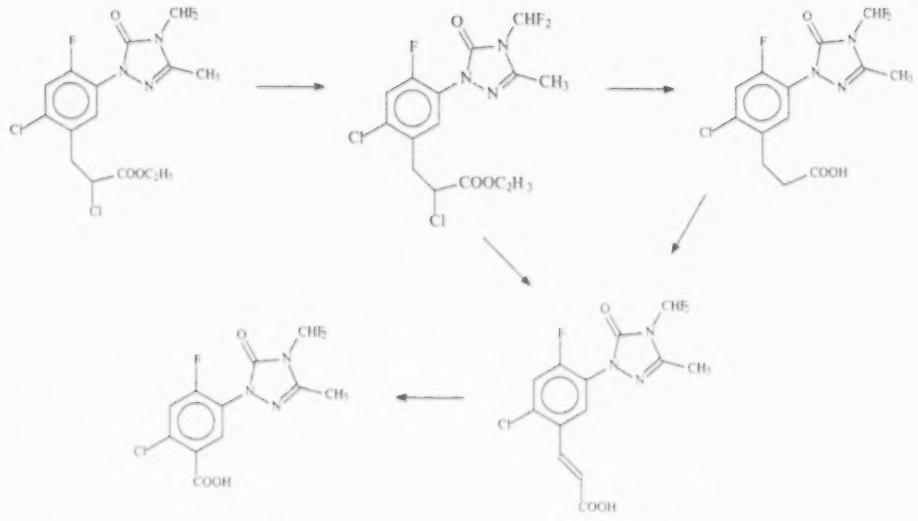
F8426-cinnamic acid
(F8426-CAc)



F8426-propionic acid
(F8426-PAc)



F8426-benzoic acid
(F8426-BAc)



Appendix II Supplemental Maximum Residue Limit (MRL) Information—International Situation and Trade Implications

Table 1 Differences Between Canadian MRLs and Other Jurisdictions

Commodity	Canada (ppm)	United States (ppm)	Codex* (ppm)
Milling fractions of barley, millet, oats, rye, triticale and wheat	0.8	0.8	No MRL established.
Milling fractions of buckwheat	0.8	0.1**	No MRL established.
Sorghum	0.25	0.25	No MRL established.
Root and tuber vegetables***, Bulb vegetables***, Leafy vegetables***, *Brassica* (cole) vegetables***, Legume vegetables***, Fruiting vegetables***, Cucurbit vegetables***, Pome fruits***, Stone fruits***, Berries***, Cereal grains*** except rice and sorghum, Oilseeds***, grapes, strawberries	0.1	0.1	No MRL established.
Fat, meat and meat byproducts of cattle, goats, horses and sheep	0.1	0.1	No MRL established.
Milk	0.05	0.05	No MRL established.

* Codex is an international organization under the auspices of the United Nations that develops international food standards, including MRLs.

** A separate tolerance is not established for buckwheat milling fractions, which are therefore covered by the tolerance for raw agricultural commodity (RAC) captured under "Grain, cereal, group 15".

*** See Appendix III for all commodities included within the named crop groups.

MRLs may vary from one country to another for a number of reasons, including differences in pesticide use patterns and the locations of the field crop trials used to generate residue chemistry data. For animal commodities, differences in MRLs can be due to different livestock feed items and practices.

Under the North American Free Trade Agreement (NAFTA), Canada, the United States and Mexico are committed to resolving MRL discrepancies to the broadest extent possible. Harmonization will standardize the protection of human health across North America and promote the free trade of safe food products. Information on the American tolerances may be found at the webpages listed below.

www.access.gpo.gov/nara/cfr/waisidx_04/40cfr180_04.html

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr180_main_02.tpl

Appendix III Crop Groups: Numbers and Definitions

Crop Group Number	Name of the Crop Group	Commodity
1	Root and tuber vegetables	arracacha; arrowroot; black salsify roots; carrot roots; cassava roots; celeriac roots; chayote roots; chicory roots; Chinese artichokes; chufa; edible burdock roots; edible canna; garden beet roots; ginger roots; ginseng roots; horseradish roots; Jerusalem artichokes; lerens; oriental radish roots; parsnip roots; potatoes; radish roots; rutabaga roots; salsify roots; skirret roots; Spanish salsify roots; sugar beet roots; sweet potato roots; tanier corm; taro corm; true yam tubers; turmeric roots; turnip roots; turnip-rooted chervil roots; turnip-rooted parsley roots; yam bean roots
3	Bulb vegetables	dry bulb onions; garlic; great headed garlic; green onions; leeks; potato onions; rakkyo; shallots; tree onion tops; Welsh onion tops
4	Leafy vegetables except Brassica	amaranth; arugula; cardoon; celery; celtuce; Chinese celery; corn salad; dandelion leaves; dock; edible leaved chrysanthemum; endives; fresh chervil leaves; fresh Florence fennel leaves and stalk; garden cress; garden purslane; garland chrysanthemum; head lettuce; leaf lettuce; New Zealand spinach; orach leaves; parsley leaves; radicchio; rhubarb; spinach; Swiss chard; upland cress; vine spinach; winter purslane
5	Brassica Leafy Vegetables	bok choy Chinese cabbage; broccoli; broccoli raab; Brussels sprouts; cabbages; cauliflower; Chinese broccoli; Chinese mustard cabbage; collards; kale; kohlrabi; mustard greens; mustard spinach; Napa Chinese cabbage; rape greens

Crop Group Number	Name of the Crop Group	Commodity
6	Legume vegetables	dry adzuki beans; dry beans; dry blackeyed peas; dry broad beans; dry catjang seed; dry chickpeas; dry field peas; dry guar seed; dry kidney beans; dry lablab beans; dry lentils; dry lima beans; dry moth beans; dry mung beans; dry navy beans; dry pigeon peas; dry pink beans; dry pinto beans; dry rice beans; dry southern peas; dry soybeans; dry tepary beans; dry urd beans; edible-podded Chinese longbeans; edible-podded dwarf peas; edible-podded jackbeans; edible-podded moth beans; edible-podded peas; edible-podded pigeon peas; edible-podded runner beans; edible-podded snap beans; edible-podded snow peas; edible-podded soybeans; edible-podded sugar snap peas; edible-podded swordbeans; edible-podded wax beans; edible-podded yardlong beans; grain lupin; mung bean sprouts; succulent shelled blackeyed peas; succulent shelled broad beans; succulent shelled English peas; succulent shelled garden peas; succulent shelled green peas; succulent shelled lima beans; succulent shelled peas; succulent shelled pigeon peas; succulent shelled southern peas; succulent shelled soybeans.
8	Fruiting vegetables	bell peppers; eggplants; groundcherries; non-bell peppers; pepinos; pepper hybrids; tomatillos; tomatoes.
9	Cucurbit vegetables	balsam apples; balsam pears; cantaloupes; chayote fruit; Chinese cucumbers; Chinese waxgourds; citron melons; cucumbers; edible gourds (other than those listed in this item); muskmelons (other than those listed in this item); pumpkins; summer squash; watermelons; West Indian gherkins; winter squash.
11	Pome fruits	apples; crabapples; loquats; mayhaws; oriental pears; pears; quinces.
12	Stone fruits	apricots; nectarines; peaches; plumcots; plums; prune plums; sweet cherries; tart cherries.
13	Berry	blackberries; blueberries; currants; elderberries; gooseberries; huckleberries; loganberries; raspberries.
15	Cereal grains	barley; buckwheat; field corn grain; oats; pearl millet; popcorn; proso millet; rice; rye; sorghum; sweet corn kernels plus cob with husks removed; teosinte; triticale; wheat; wild rice.

Crop Group Number	Name of the Crop Group	Commodity
20	Oilseed	flaxseed; Indian mustard seed; Indian rapeseed; mustard seed; rapeseed (canola); safflower seeds; sunflower seeds.